SCIENTIFIC AMERICAN

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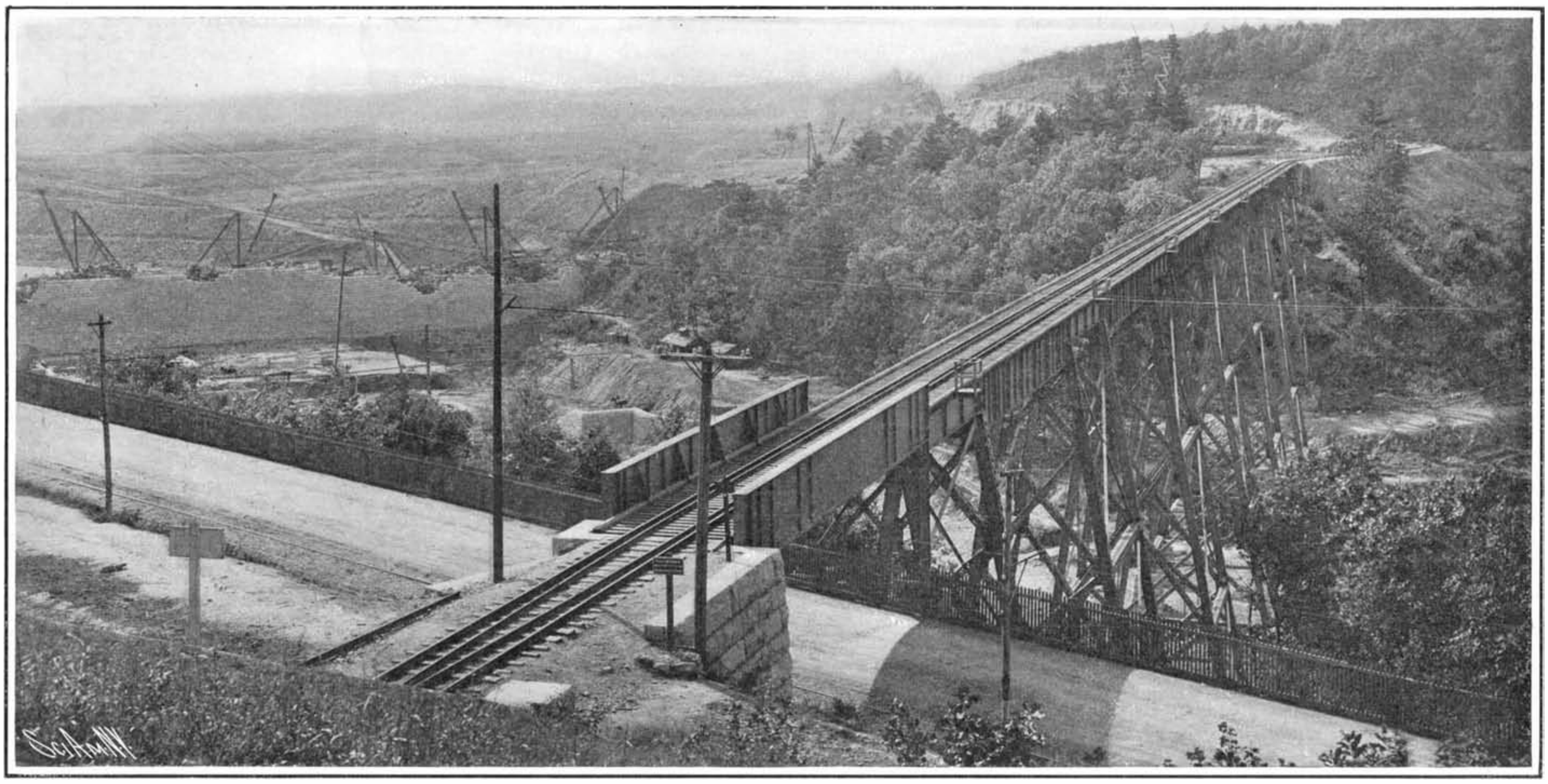
Vol. XCIII.—No. 1. ESTABLISHED 1845.

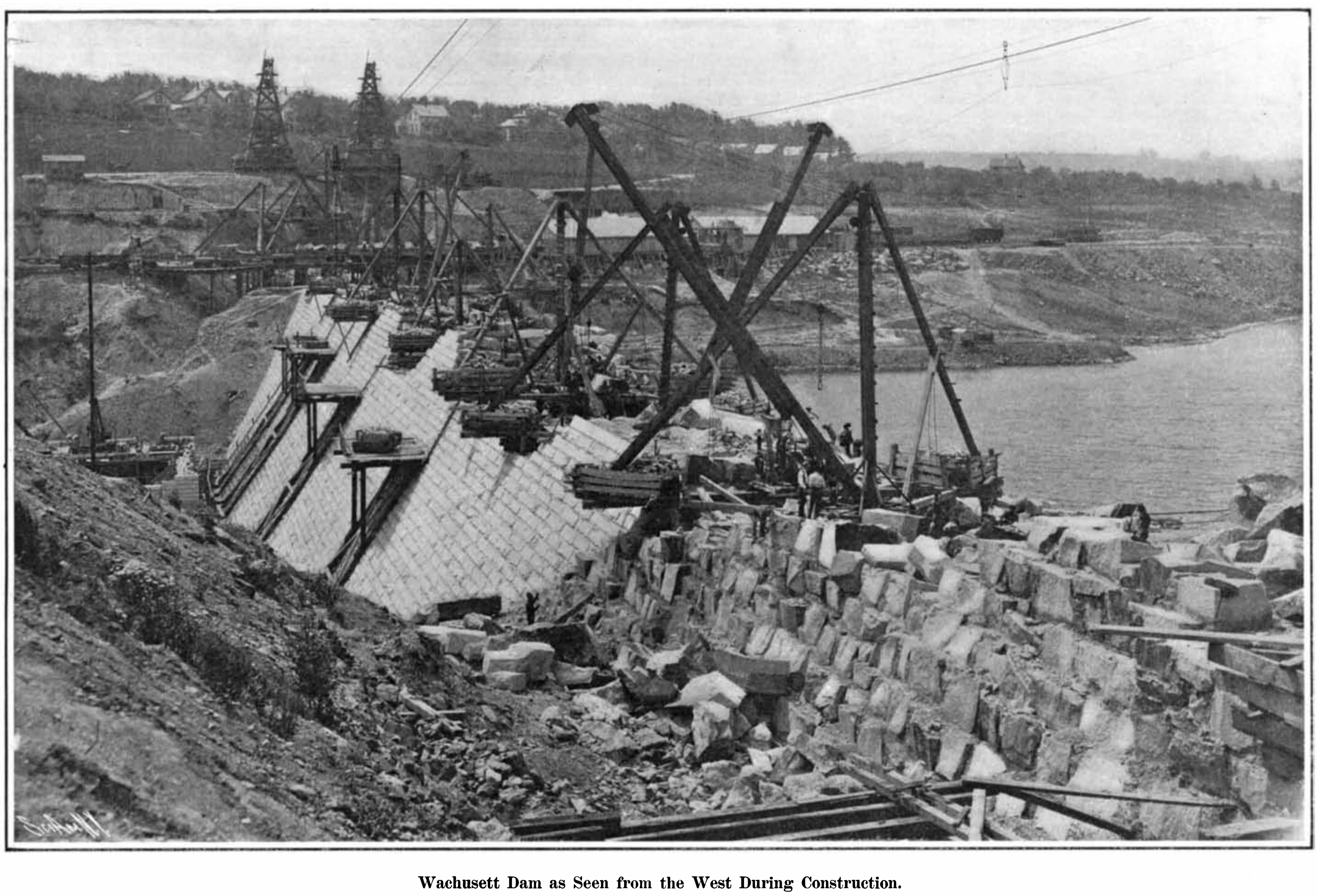
NEW YORK, JULY 1, 1905.

[8 CENTS A COPY. $3.00 A YEAR.]



Total length, 921 feet; height above valley, 133 feet. This viaduct forms part of several miles of rebuilt line necessitated by the formation of the reservoir.

Viaduct Built to Carry Central Massachusetts Railway Across Nashua River Below the Dam.



Wachusett Dam as Seen from the West During Construction.

THE WACHUSETT DAM, STORING 63,000,000,000 GALLONS FOR BOSTON WATER SUPPLY—THE BIGGEST RESERVOIR IN EXISTENCE.—[See page 11.]

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ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid, £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845)	$3.00	a year
Scientific American Supplement (Established 1876)	5.00	"
American Homes and Gardens	3.00	"
Scientific American Export Edition (Established 1878)	3.00	"

The combined subscription rates and rates to foreign countries will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.

MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, JULY 1, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

AMERICAN HOMES AND GARDENS—THE NEW MAGAZINE.

The publishers of the SCIENTIFIC AMERICAN begin this week the publication of a new monthly illustrated magazine, entitled American Homes and Gardens. It is at once a new series of the SCIENTIFIC AMERICAN Building Monthly, and a new magazine of the home—new in idea, new in spirit, new in form, new in plan and execution.

American Homes and Gardens will speak of the home and to the home. In speaking of the home it will present in the highest type of modern illustration, pictures and views of houses, within and without, already completed and occupied. In speaking to the home it will address itself to home betterment, home improvement, home uplifting in so far as the house—the building—is concerned.

The architectural point of view which was developed in the SCIENTIFIC AMERICAN BUILDING MONTHLY will be broadened and expanded in AMERICAN HOMES AND GARDENS. Good building is the foundation of good home life, and it is this aspect of building which will be treated in every possible phase. The importance of the garden in home development is almost as great as that of the house; for the garden gives that outward touch of beauty which adds to the perfection of a well designed home. The house and the garden are, in fact, but two aspects of the home idea; and it is of these that AMERICAN HOMES AND GARDENS will treat.

The programme is a broad one and will be developed in the broadest possible way. Home betterment is related to many things which do not enter immediately into the problems of house construction or of garden design. If these matters may be called lesser it will not be because they are of minor importance, but because not being concerned with actual problems of brick and mortar, of wood and stone, they are not always classed with building problems. AMERICAN HOMES AND GARDENS is not a building magazine, but a journal of the home, an infinitely wider, broader, nobler theme, concerned with some of the weightiest problems before the American people.

The new magazine begins with the number for July, now ready on all news stands. A half dozen houses of real interest, and thoroughly illustrated, with interior views and plans, form the architectural contents of the number. There is an elaborate account by Barr Ferree of Mr. Eben D. Jordan's fine country seat, "The Rocks," at West Manchester, Mass. Harry Dillon Jones describes the successful experiments in manufacturing cement garden statuary by Mr. M. R. Mercer. Joy Wheeler Dow begins a notable series of papers on "Principles of Home Decoration." Alice M. Kellogg writes on "The Dining Room of the Past and the Present," and Charles F. Holder contributes an entertaining account of "The Spanish Missions in Texas and Arizona." Other articles include "Helps to Home Building," "Furnishing the House," "Science for the Home," "The Garden," "The Household," "Civic Betterment—The Kitchen," "New Books," and many valuable and practical notes on house building and equipment. The magazine is beautifully and copiously illustrated, and is the handsomest home magazine yet published.

ATMOSPHERIC CONDITIONS IN THE SUBWAY.

Much surprise has been expressed that the temperature of the Subway should have been so nearly equal to that of the street surface during the periods of hot weather that have recently visited this city. When on a hot day the suburban resident had occasion to enter the cellar of his frame cottage, he noticed the refreshing coolness of the air as soon as he had descended below ground level. He argued that the Subway, being entirely below the street, would be relatively as cool as or even cooler than his cellar. His expectations were strengthened by the fact that whenever he happened to enter the Subway during the closing weeks of its construction, he found that the interior atmosphere was particularly cool and refreshing. With the advent of the warm weather, these expectations have been cruelly disappointed, and it is a fact that at various times during the recent hot spell, especially after a sudden drop of temperature on the street, the Subway has been many degrees warmer than the street.

The explanation is not far to seek: It is to be found in the fact that the movements of the trains, and the abundant entrances at the stations, together cause a very thorough circulation of air, the cold air being driven out of the Subway, and warm air from the surface sucked in, with the result that temperatures on the street and in the Subway are soon equalized, and the expected cellar-like coolness is altogether wanting. Although these facts are pretty well understood by engineers, the general public has mistaken the high temperature for a lack of ventilation, interpreting the "stuffiness" as an indication that the Subway air is impure. As a matter of fact it can be safely said that the more nearly the temperature in the Subway approaches that of the street, the more thorough is the ventilation—the high temperature being the price we pay for the circulation of air. If the Subway, for some reason, were to remain unused for a week or two, with no trains running, no passengers on its platforms, and with the entrances closed up, the temperature would fall steadily until on the hottest days it would be found to be, between stations, a great many degrees cooler than at the surface.

There are, of course, secondary causes that add to the discomfort, such as the heat of the motors, of the electric lights, and that due to the presence of so many hundred thousands of people within the Subway, to say nothing of the effect of the glass-roofed stations. In connection with the last-named cause of discomfort, the question of the abolition of the glass-lighted roofs becomes a legitimate subject of discussion for the engineers who now have the question of Subway atmospheric conditions under consideration. The abolition of these lights would undoubtedly render the stations cooler in the hot weather, and the addition of a few arc lights would give all the necessary lighting.

A CITY OF TOWERS.

The announcement that one of the largest insurance companies, whose premises cover an entire block in the center of this city, is about to enlarge the capacity of its offices by the erection of a tower over 500 feet in height, suggests that in the coming years the skyline of New York city may be pierced by many such structures. That a tower of this height is not considered to be architecturally impossible of successful treatment, is suggested by the fact that in the plans submitted under the last administration for the erection at the Brooklyn Bridge terminus of a combined railroad station and department offices, the architect contemplated a tower building which was to be something over 600 feet in height. The statement has been frequently made that although there is no structural reason why buildings should not be carried up to a height of 500 feet or more, the area required for the elevator service would be so large, and would cut so deeply into the rentable floor space, as to render such a building commercially unprofitable. That question, however, would be determined by the relation of the area of the ground plan to the height of the building. In the case of the insurance company's building, above referred to, the ground plan of the tower is to measure 150 by 75 feet, a total of over 11,000 square feet. On a ground plan of these dimensions, it would be possible to establish an ample elevator service to the very top of the tower, without encroaching too heavily upon the rentable floor space. Of course, every one who is interested in the architectural appearance of this city deplores the exaggerated height of its buildings, many of which, even though they do not exceed 250 or 300 feet in height, are still, as regards the proportion of base to height, veritable towers. Unfortunately, in the earlier days of construction of such buildings, our architects made the fundamental mistake of trying to reduce their apparent height by accentuating the horizontal lines thereof. This was a radical error. What they should have done was to accept the situation, and endeavor to accentuate the vertical as against the horizontal lines, and honestly endeavor to make the buildings look the towers that they were. In one or two cases, in such buildings, this has been done with very happy effect, and it still remains for one of our less conservative men to take, let us say, one of the beautiful cathedral towers of Europe as a model, and by grouping the window spaces and accentuating the vertical lines, reproduce something of the effect of the great Gothic windows and other characteristic effects of these handsome structures.

The reasonableness of this suggestion is shown in the undeniably handsome effects produced by the Gothic treatment of the new Trinity building. If Gothic details can do so much to redeem the vast blank wall of this structure, what might it not have accomplished if applied to such a tower as the American Surety or the St. Paul building?

ARE FAST TRAINS DANGEROUS?

The fact that one of the new 18-hour trains to Chicago has been wrecked, with a long list of fatalities, and that immediately after the wreck the company reduced the speed to the former twenty-hour schedule, will naturally lead the general public to the belief that such trains are inherently dangerous. They will think so, in spite of the fact that in the official notification made by the president announcing the withdrawal of the train, it is expressly stated that such withdrawal is not to be taken to indicate that there are any physical dangers attending its operation. At the present writing, the evidence seems to point to the fact that the train was wrecked through the misplacing of a switch by some maliciously-disposed person, and if this was the case, the disaster is no more due to the high speed of the train than it would have been to that of a train running at one-half the speed. We will go further and say that the chances of the engine breaking through or jumping over a misplaced switch, and taking the main line again beyond it, would be greater in a fast than in a slow train.

The reducing of the schedule from eighteen hours to twenty is due to considerations, not of any engineering difficulties attending an eighteen-hour train as such, but to the popular prejudice which will inevitably consider the speed of the train and the accident in the relation of cause and effect.

Not only has the recent accident no bearing one way or the other on the safety of high-speed trains, but as a matter of fact a fast train such as this is, for several reasons, the safest one that a passenger can select out of the many trains that are at his service. This will be evident from the following considerations:

First. Because of the prestige which attaches to a "flyer" the company selects its very best rolling stock, and places at the head of the trains its most reliable engines, the master mechanic taking particular care that they shall be in perfect running condition.

Second. The train crew is specially selected, the enginemen and conductors being chosen on their records, and being in every case men of long experience on the divisions of the road which they have to cover.

Third. Since the eighteen-hour train represents the highest development of the constructive and operative departments of the railroad, it becomes an object of special pride and solicitude to every one on the system who is concerned directly or remotely in its successful running. It is given the right of way over all other trains. Switchmen, signalmen, station agents, the crews of other trains that it may overtake or meet, follow the movements of the "flyer" with close attention, watch for its coming, and in the earlier days of its running, give it God-speed as it flashes by. Whatever train may come to grief through forgetfulness (that fruitful source of train disasters), it is safe to say that your "eighteen-hour" trains, your "lightning expresses," "flyers," and what not, are not likely to be among the number.

Fourth. On the straight stretches of the line the fast train, because of its higher velocity, is less likely to be thrown from the track by some obstruction than the slow train. The writer was once on an engine that was thundering down grade, through the "Bad Lands" of Dakota, with a ten-car train behind it, at a speed of over sixty miles an hour, when the engine struck and swept through a band of wild horses, that dashed out of a neighboring canyon across the track just as the train was upon them. The engine and train kept the rails unharmed. At another time he was on an engine that was crawling slowly up grade, when a small band of sheep crossing the tracks proved enough to derail the engine. It takes but a very small force to deflect a billiard ball that is rolling slowly across a billiard table, but if that same ball were moving at the rate of 100 feet a second (a frequent speed for these fast expresses) it could only be deflected by the exercise of considerable force. It is the instinctive recognition of this fact that has led some engineers, when they have seen that they must hit a comparatively light obstruction, to increase rather than retard the speed of the train. Indeed, it is a matter of record that on one occasion the "Twentieth Century Limited" cut through a box car that had been thrown across the track immediately in front of it, with so little disturbance to the train that the passengers knew nothing of the occurrence. On a slow train, a derailment would have been almost certain.

Fifth. On moderate curves the danger of jumping the outside rail, even by the fastest trains, is practically eliminated by the superelevation of that rail. On sharper curves, where the running instructions call for a slowing down of the speed, the risk of derailment is, we think, less with the train having the fastest schedule than with the slower train. And this for the reason that while the engineer of the flyer knows that he must slow down in any case, the engineer of the local or slower train, not being accustomed to slacken speed at such and such curves, is liable, and often does, when he is late and making up time, negotiate these curves at a speed much higher than is allowed. During a ride which the writer took some years ago on an engine of

the "Twentieth Century Limited," he was impressed with the great care with which the enginemen slowed down on curves that exceeded a certain degree. During many years of observation of the action of trains on sharp curvature we have never known a fast express to run around curves at a speed exceeding the safe one, but we have many times seen such speed exceeded on slow and heavy trains that were endeavoring to make up time on down grades where the curvature was heavy.

Sixth. In the event of collision, the actual smashing effects, and therefore, the fatalities, are likely to be less in the fast than in the slow passenger train. The former will be made up of four or five cars, the latter of from eight to ten; and since the crushing in of the cars and wounding of the passengers is due to the total momentum of the train, all of which must be expended before the cars come to a state of rest, it follows that the wreckage of the ten-car train, moving at fifty miles an hour, would be far greater than that of the five-car train moving at sixty miles an hour—and this in spite of the fact that the momentum increases as the square of the velocity. In other words, it will require the crushing up of more cars to absorb the momentum of the slow heavy train than it will that of the light fast train. Had the misplaced switch been open in front of the slower nine-car "Lake-Shore Limited," for instance, the casualties would undoubtedly have been much heavier than they were in the present case.

Lastly, the fast train, like the fast transatlantic liner in a fog, is sooner through the danger space. This argument, which is accepted among steamship captains as a perfectly sound one, applies in its degree to railroad travel, for if dangers lurk on the rails, the sooner the journey is over, other things being equal (and we have shown above that "other things" rather favor the fast train than otherwise), the less the danger of injury.

We have gone somewhat fully into this question, because we believe that it affects, in the most vital way, the whole question of the increased speed of so-called express American railroad trains, which to-day, except for a few special trains, is lamentably behind that of some foreign countries. Every day of the year in France over thirty trains are run that have a schedule speed of from 55 to 60 miles an hour; and in Great Britain there are over fifty such trains. Time was when the immature state of our railroads could be urged as a plea for the low average speed of the majority of our express trains. No such plea can be urged to-day, for our best track is just as good as the best track in European countries.

THE HEAVENS IN JULY.

BY HENRY NORRIS RUSSELL, PH.D.

Two very interesting announcements have come from American observatories recently. One is from the Lowell Observatory, stating that photographs of Mars showing some of the canals have been secured there. This, if confirmed, will remove all question of the reality of these much discussed phenomena. The other is from Harvard and conveys the news that another satellite of Saturn has been discovered photographically by Prof. W. H. Pickering, raising the number to ten. It is an exceedingly faint object of about the 17th magnitude, even fainter than the ninth satellite, but in other respects it is quite unlike it or the two new satellites of Jupiter. Instead of being a distant attendant it is relatively close, having a period of about 21 days, which corresponds to a distance of about one million miles from the planet, and it revolves from west to east like the inner satellites and Saturn itself.

These values are very close to the corresponding numbers for the faintest of the old satellites, Hyperion, but Prof. Pickering's statement that Hyperion is visible on his photographs and is three magnitudes, or nearly twenty times, brighter than the new satellite disposes of all question as to their identity. It seems that here we have two satellites whose distances and periods are very nearly alike.

No such case has previously been known among satellite systems, but in the solar system the asteroids furnish an excellent analogy, for among them it is possible to pick out many pairs whose orbits are very nearly alike both in size and shape.

We may pursue the analogy further, for the new satellite is very small, probably not over 100 miles in diameter, while the largest of Saturn's satellites, Titan, has a diameter of about 3,500 miles, and the planet itself of 73,000, so that the new satellite is smaller in comparison to Titan than the latter in comparison to Saturn itself. Finally to complete the likeness, the orbits of the asteroids lie just *inside* that of Jupiter, which is much the largest of the planets, and the orbits of Hyperion and the new satellite lie just *outside* that of Titan, which is by far the largest of Saturn's satellites.

Is this remarkable similarity an accident or can we assign a reason for it? To answer this question we must enter for a moment into the realms of mathematical astronomy, where we have not to seek far for an explanation.

Every planet is attracted not only by the Sun but by all the other planets, and the closer together two of them are, the greater will be the attraction. If, therefore, two planets of considerable size had orbits which approached very near one another at any point, sooner or later they would both come near this point at the same time. Their mutual attraction would then be so great that it would alter the direction in which they moved, and after the encounter they would pursue quite different orbits from their previous ones. In certain cases the orbits might be so profoundly changed that one of the two might collide with the Sun, or be sent away into space never to return, as a result of the encounter.

Such things are liable to happen unless both the planets are very small so that their mutual attraction is insufficient to affect their motions perceptibly. We see, therefore, that the small size of the asteroids is a necessary condition for their *permanently* continuing to move in the orbits which they now possess.

But what does the neighborhood of Jupiter have to do with the existence of these small planets? Here we must go farther back into the probable history of the solar system. It is generally believed that the planets have condensed to their present forms out of much more sparsely distributed matter which perhaps once formed rings or something of that sort revolving about the Sun. Whether the parent matter of the asteroids formed a ring or not, it must have come much nearer to Jupiter than that of any of the other planets did. Now it can be shown that the attraction of Jupiter would tend to tear any such diffuse mass into separate bits. It seems therefore quite likely that the asteroids represent a planet "spoiled in the making," owing to the relative nearness of Jupiter, which prevented it from condensing into a single piece as the other planets, farther away from this disturbing influence, did.

Just the same reasoning will evidently apply in the case of the Saturnian system, where the planet takes the place of the Sun and Titan that of Jupiter. So we see that the likeness we have already mentioned is not a mere accident, but can be explained on gravitational principles.

It is tempting to extend the analogy still farther and to suggest that Hyperion and the new satellite may be only the brightest members of a group of Saturnian asteroids, but the extreme faintness of the newly-discovered object suggests that even if there are more still smaller ones they may be too faint to see or photograph.

THE HEAVENS.

Clear summer nights give us our best opportunities to became familiar with some of the brightest of the southern constellations. Scorpio, the finest of these, is on the meridian at 9 o'clock July 15, and in our latitude the whole constellation can be seen. It consists of a vertical line of three second-magnitude stars, then to the left another group of three, the central one of which is very bright and very red, and a long curving line running from these down almost to the horizon and bending back again to form the monster's tail. East of Scorpio is Sagittarius and above the two are Ophiuchus and Serpens. Above these again are Hercules and Corona. Lyra and Cygnus are farther east, near the Milky Way, and Aquila is south of them. Andromeda, Pegasus, and Capricornus are rising, but not conspicuous yet. West of the meridian the most prominent objects are Arcturus, Spica, and Mars, the latter the lowest of the three. Leo is settling in the west and Ursa Major is above and to the right of it. Draco and Ursa Minor are above the pole and Cepheus and Cassiopeia on the right.

THE PLANETS.

Mercury is evening star in Gemini, Cancer, and Leo. At first he is close to the sun and invisible but at the end of the month he can be well seen, as he sets at about 8:30 P. M.

Venus is morning star in Taurus. On the 6th she reaches her greatest elongation, being a little more than 45 deg. west of the sun. She rises about 2:30 A. M. and is the brightest thing in the morning sky. Mars is in Libra and is prominent in the evening sky, settling about midnight. Jupiter is morning star close to Venus. The closest conjunction occurs on the 4th when they are only 2½ deg. apart. Saturn is in Aquarius and rises at about 10 P. M. in the middle of the month.

Uranus is just past opposition, and is well observable. He is in Sagittarius, his position on the 15th being R. A. 18h. 6m., dec. 23 deg. 42 min. Neptune has just passed conjunction with the sun and is invisible.

THE MOON.

New moon occurs at 1 P. M. on the 2d, first quarter at 1 P. M. on the 9th, full moon at 11 A. M. on the 16th, last quarter at 8 A. M. on the 24th, and new moon once more at 11 P. M. on the 31st. The moon is nearest us on the 10th and farthest away on the 23d. She is in conjunction with Mercury on the 3d, Mars on the 11th, Saturn on the 19th, Jupiter on the 26th, and Venus on the 28th.

Cambridge University, England, June 13, 1905.

ENGINEERING NOTES.

Multiple screws were used as early as our civil war on some vessels known as "tin-clads" on the Mississippi, their adoption being necessitated by the shallow draft. Twin screws were first used in war vessels where the necessity for keeping the machinery below the deck would not allow of all the power being conveniently used on a single shaft, but the great advantage they possess of security against total disablement and for maneuvering soon made them the rule for all naval vessels large enough to admit of them. They were much longer in coming in the merchant service where the limitations on naval machinery do not obtain, but since the era of the very large transatlantic steamers beginning with the "Paris" and "New York," and the "Teutonic" and "Majestic," all very large vessels have been built with twin screws.

In the early steamers, almost the only independent steam auxiliary was a single pump which could be used for feeding the boilers while under banked fires or with the engine stopped, and for pumping the bilge. The other pumps were attached to the main engine. Such things as steam capstans and winches, steam steering gear, distilling apparatus, evaporators, forced draft blowers, and electric light engines, were not dreamed of. As time went on and the size of vessels increased, steam capstans and winches and steam steering engines came in. Then it began to be found desirable, particularly for naval engines, to remove all the pumps from the main engine, leaving it nothing to do but turn the propeller, and this brought about independent air and circulating pumps and feed pumps. Further progress introduced the distiller and evaporator, the forced-draft blowers, and the electric light engine.

Submarine boats made a brilliant performance at the recent maneuvers which the French navy carried out in the bay of Toulon. This is the first time that such maneuvers have been held in France. The idea was to combine the operations of the submarines of the port with the torpedo boats which form part of the defending fleet. The operation was as follows: A polygon had been traced in the great harbor. This polygon, which had a surface of some 3,000 square yards, was formed on one side by the shore and on the others by imaginary lines which had been determined in advance. A squadron composed of six torpedo boats of the fleet, headed by the destroyer "La Dragonne," was detailed to defend and keep a lookout upon the polygon. On the other hand, five submarines were to traverse the space from one end to the other, without being seen or localized by the torpedo boats. The maneuver took place during the forenoon. It proved to be of a most instructive character, and gave some very conclusive results as to the operation of the submarines. The torpedo boats, which had an entire freedom of movement, ranged themselves at the extremity of the polygon, and facing the shore, on a line parallel to the latter, so as to have a wide field of vision before them. The sea was remarkably calm and exceptionally transparent at that time, which gave the least favorable conditions for the submarines. Besides, these small craft are the oldest of the series and the first to be built, so that they had not the benefit of the great improvements which have been recently made. The "Zédé," the "Gymnote," and three other submarines of the same type were ranged in line. In spite of the clearness of the water, the freedom of movement of the torpedo boats, and the sharp lookout which the officers and crew kept up in order to note the smallest disturbance at the surface, the five submarines were able to traverse the whole width of the polygon and were quite invisible, and no one was able to reveal their presence or to say at what time they had passed across the space. Only one of the torpedo boats, the No. 140, in the report which it presented to the commandant of the defense, stated that during a few seconds a slight bubbling was noted, this no doubt being caused at the surface of the sea by a periscope which came near the top, but the duration of the disturbance was so short that no exercise of sighting could be made, and in spite of the efforts which were made at once, it was quite impossible to discover the path of any of the submarines. The naval authorities here consider that this experiment which is tried for the first time with the torpedo boats and submarines, is among the most important and conclusive, and justifies the confidence which the navy has in the good performance of the submarines.

The railway companies in Switzerland have determined that for the future all children under 2 feet 1 inch in height will be passed at half fare, and those above, whatever their ages may be, will be treated exactly as adults. At each station, near the booking-office, a measuring machine is to be fixed, and whenever a child applies for a half-fare ticket it will be invited to stand under the scale.

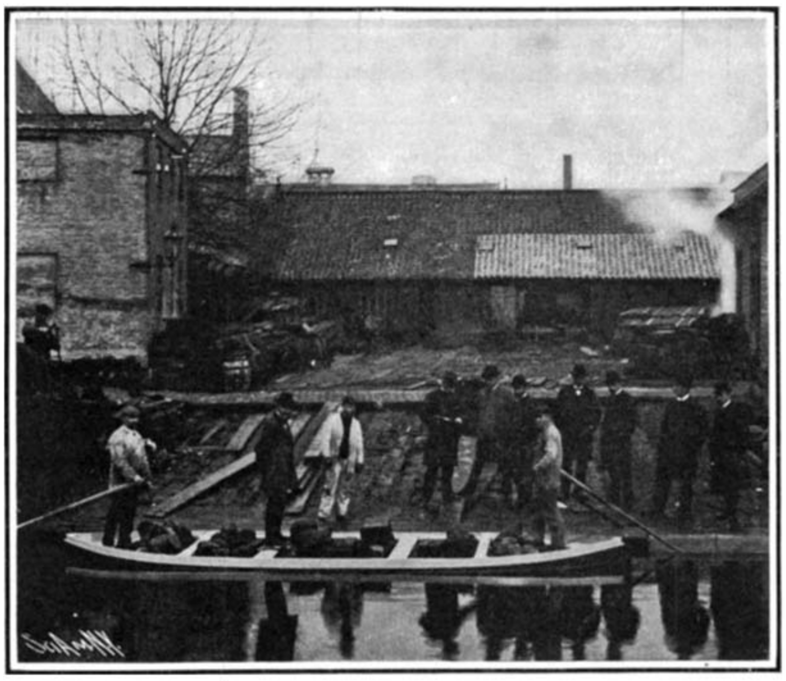
THE ENGLEHARDT UNSINKABLE LIFEBOAT.

BY RANDOLPH I. GEARE.

About one hundred and twenty years ago the first patent was taken out for a lifeboat. Four years later (1789) Henry Greathead, of England, patented another kind which proved very successful, and continued to be almost the only one in use till 1851, when fifty models of improved lifeboats were exhibited at London in competition for a prize offered by the Duke of Northumberland. A boat designed by James Peake, of Woolwich Dockyard, then became the recognized model, and was universally adopted as the standard.

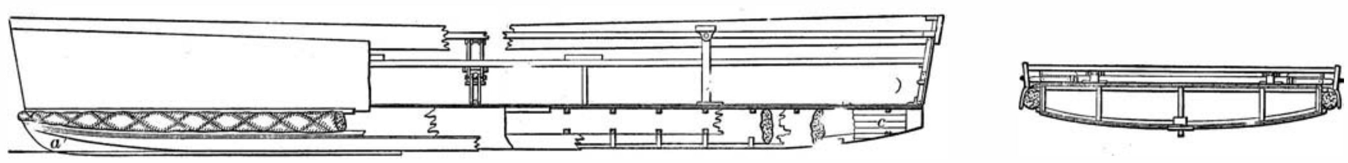
The principal essentials in a lifeboat are great lateral stability, speed against a heavy sea, facility for launching and taking the shore, immediate self-discharge of any water breaking in, the power of self-righting if upset, strength, and plenty of passenger space.

The latest lifeboat to aspire for first honors is the "Englehardt," recently invented in Copenhagen. It is about twenty feet long, and is said to combine the requirements of the smallest space with the utmost carrying capacity.



TWENTY-ONE-FOOT ENGLEHARDT COLLAPSIBLE LIFEBOAT UNEXPANDED.
Load 4,500 pounds.

In case of shipwreck, if time should not allow the lowering of these boats, the lashings need only be cut, and when the ship has sunk, the boats will be found floating like rafts, and easily accessible for passengers who may be swimming or drifting about. Two persons can extend the sides in a few seconds by simply lifting in the cross-beams, and thus converting the boat-shaped raft into a lifeboat containing oars, bread, watertanks, etc.



Longitudinal and Cross Sections of the Englehardt Boat.

The principles of this boat are (1) a boat-shaped pontoon of wood or iron, filled with kapok (the product of plants growing in Java and Sumatra) carried in water-tight cushions, which again are placed in water-tight compartments. Kapok is said to combine the greatest floating capacity with the least weight, and will sustain from thirty to thirty-five times its own weight in water; and (2) a superstructure which can be folded down or erected, the whole surrounded by a fender also filled with kapok, in water-tight cushions.

In extending the boat, the oars are released, an oval-shaped-thwart supplied with cross-thwarts slides into position, and stanchions and other parts drop into their places automatically.

TWENTY-ONE-FOOT COLLAPSIBLE LIFEBOAT EXPANDED.
Twenty-two men are trying to list her over.

The lower part of this boat is a buoyant layer, consisting of a keel, one amidships keelson, two side keelsons, two double side-strakes, all of which are connected by cross-timbers and carlins and are fastened to the stem and stern posts. The bottom as well as the deck in this layer is planked with boards laid lengthwise under the bottom, and diagonally on deck. The deck canvas reaches two or three inches down on the side-strake, the bottom canvas the same distance up on the deck. Both layers of canvas are then covered on deck by a second layer of boards crossing the first at a right angle. The bottom canvas is further covered below a layer of boards and on the sides by the second side-strake. On each side of this buoyant layer, two narrow battens are fastened to the side-strakes for lashing the fender, which consists of short cushions made of prepared water-tight canvas stuffed with kapok and surrounded by a strong canvas cover. Between the three keelsons are placed cushions, likewise water-tight and stuffed with kapok, while the peaks "fore and aft" are filled with cork. The top stanchion consists of a rail, to which is bolted a gunwale or sheer strake, and which is connected to the lower structure by toggle joints or hinged uprights. Two cross-beams are likewise bolted to the rail, each furnished with stanchions.

Launch of a New Japanese Battleship.

The latest addition to the Japanese navy is to be launched from the shipyard of Messrs. Vickers, Sons & Maxim, Ltd., Barrow (England) on July 4, by Princess Arisugawa. This is the "Katori," which is practically identical with the "Lord Nelson" class now in course of construction for the British navy, being of 16,000 tons displacement. The vessel has a length of 420 feet; beam, 78 feet; coal supply, normal, 750 tons, full, 1,800 tons; mean draft, 27 feet; indicated horsepower, 16,000; speed, 18½ knots. The fighting armament comprises: Four 12-inch (45-caliber) guns in barbettes of armor 10 inches thick; four 10-inch (45-caliber) in barbettes of 6-inch armor; twelve 6-inch, all protected (ten will be in a 6-inch armored battery); ten 12-pounders and two 12-pounders for landing purposes; three 3-pounders; six Maxims; five 18-inch submerged torpedo tubes, four on the broadside and one aft. The main features of the armor protection are a complete waterline belt 9 inches thick, tapering aft to 2½ inches thick, and an intermediate belt forming the base of the armored main deck battery varying from 6 inches to 4 inches. The conning tower and the communication tube are 9 inches thick, and there is also to be an observation station of 5-inch thickness.

AN APPARATUS FOR INDICATING THE VIBRATIONS OF SOUND WAVES.

BY EMILE GUARINI.

The object of this apparatus, recently invented by Mr. William Stern, of Breslau, and constructed by the Max Kohl establishment, of Chemnitz, is, through an absolutely continuous variation of the pitch of the sound, to embrace, in a large measure, the series of sounds in such a way that any number whatever of vibrations may be immediately produced and read upon the apparatus as soon as obtained. As long as it resounds, the sound has a constant intensity, and does not continue to decrease as in the tuning fork. The apparatus consists of a series of vessels of different sizes, each embracing an octave, and each consisting of a brass cylinder surmounted by a zinc cap provided with a short pipe and soldered to the cylinder. The bottom of the latter is hermetically closed by a piston, the upward and downward motions of which produce the variations of the sound. For the production of the sound the cylinder is placed in the path of a current of air directed obliquely upon the short pipe end by means of a flattened nozzle. The air may be driven into the latter by means of an ordinary bellows arrangement, for which may be substituted the apparatus shown in Fig. 2. A substitution of this sort is advantageous in the first place because it dispenses with the necessity of continually actuating pedals, and, in the second, because it does away with the production of slight vibrations isochronous with pedaling. The new apparatus is based upon the principle of gasometers. It consists of a large iron plate cylinder open at the bottom and descending by its weight into a tank filled with water. This motion drives out the air imprisoned above the water, with a pressure of about 15 millimeters of mercury. This compressed air passes into the tube and enters the regulating one of the diversifier. Now, since as the cylinder enters the water it loses its weight, and the pressure of the air must therefore diminish, a very interesting arrangement has been devised to prevent such diminution. Upon the descending holder there is an annular receptacle which communicates, through another, with a glass tube filled with water and placed upon the side of the table. This is seen at the left in Fig. 2. When the holder, and consequently the annular receptacle, descends, a certain quantity of water passes from the glass tube into the receiver. It is a question, therefore, merely of giving the two communicating vessels dimensions such that the weight of the water introduced shall balance the loss of weight by immersion. When the holder is completely submerged, it suffices to pull a cord in order to raise it to its former level. The pulling of the cord opens at the same time a valve which allows air to enter the holder in measure as it ascends. After the ascent of the holder, it is possible to pursue for several minutes the study of the sounds produced by the apparatus with an always equal intensity. The cylinder resounds as long as the current of air lasts. The pitch of the sound is modified during this time by raising or lowering the piston.

It would evidently be possible, by the use of one or more transmissions, to actuate the piston very slow-

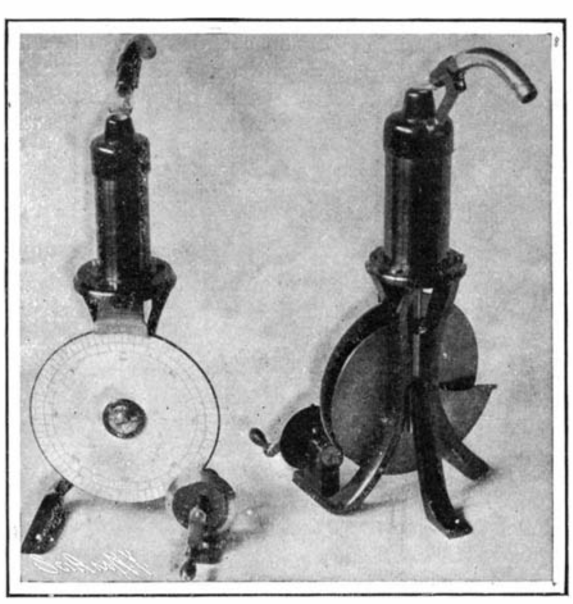


Fig. 1.—FRONT AND REAR VIEWS OF NEW FORM OF VIBRATION-INDICATING SIREN.

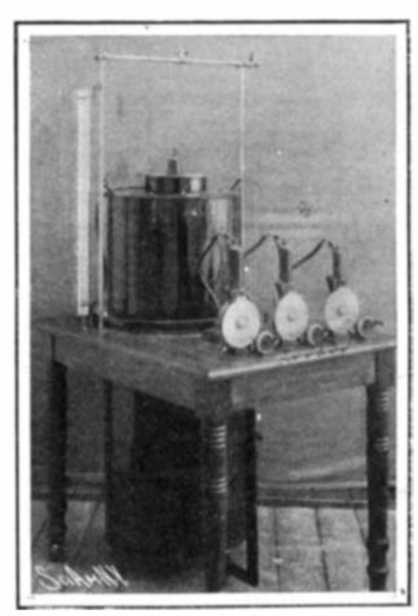


Fig. 2.—CONNECTED SIRENS AND AIR PRESSURE APPARATUS.

ly, and consequently to obtain an infinite and insensible gradation of the sounds. Very great difficulties, however, are met with in the way of satisfying another requirement of great importance in apparatus of precision—and that is the regular and uniform modification of the pitch of the sound. When the piston ascends, the sound does not rise in a regular manner, but with an ever-increasing velocity, because the pitch is not inversely proportional to the height of the column of air in vibration, but to the square root of such height. An inconvenience therefore presented itself. Upon turning the crank in order to raise or lower the piston, each revolution had a different effect upon the variation of the sound. This difficulty has been surmounted in the following manner: The piston rod is displaced by means of a roller upon the edge of a disk revolving vertically. When the roller rests upon the point at which the radius of the spiral is smallest, the bottom of the cylinder will be situated in its lowermost position. If, on the contrary, it rests at the point at which the radius is maximum, the bottom of the cylinder will be in its uppermost position. The spiral is so planned that at the minimum radius it is very narrow, and that in measure as the radius increases it becomes more open. In this way, in proportion as the crank is turned, the elevation (per revolution) of the piston becomes less. It is in this way that the irregularity mentioned above has been overcome. Upon the same axis with the spiral, and turned toward the experimenter, there is a graduated circle that carries the indication of the number of vibrations and of the musical tone, and that revolves at the same time as the spiral and passes before a stationary index. On this, it is possible at every instant to read the number of vibrations obtained. This axis is connected, through a 1:10 transmission, with another to which the crank is fitted. To the crank is adapted a second graduated circle, which permits of inserting fractions between the vibrations indicated on the principal dial.

As may be seen in Fig. 2, several of these apparatus are fixed upon the same table. Their scales of sounds encroach upon one another because it is sometimes necessary to obtain the same sound from two instruments at once.

A front and a rear view of the apparatus are given in Fig. 1. In addition to this type, the maker is constructing one that is less precise, and is adapted for less accurate researches and for school demonstrations. In this the spiral is done away with, and the piston is actuated directly by a rack and pinion. Owing to a special arrangement, it has been possible, despite the unequal variation of the sounds, to indicate exactly the number of vibrations of each sound upon the scale.

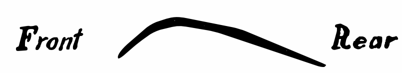
THE BIRD AS A MODEL FOR THE AEROPLANE.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Since the fatal results that attended the experiments of Lilienthal and Pilcher in the solution of the problem of aerial flight, further investigations in this direction have been somewhat neglected in favor of aeroplane and balloon researches. During the past few months, however, an impetus has once more been imparted to the problem of flying by three British investigators, Messrs. E. P. Frost, Dr. F. W. H. Hutchinson, and C. R. D'Esterre. The result of their efforts and the data they have gathered from their investigations were recently communicated to the Cambridge University Society, and have aroused considerable interest.

These experimentalists have taken the wings of a bird as the basis of their efforts. As is well known, a bird's wing consists essentially of two portions: (1) That part to the outer side of the wrist joint, the main feathers of which are about ten in number and are known as the primary feathers; and (2) that part to the inner side of the wrist joint, which may be described as the body of the wing, and the main feathers of which vary according to the length of the wing.

The salient characteristic of a bird's wing as a whole is the comparatively rigid and heavy anterior edge and the light, yielding, elastic posterior margin. If the primary feathers be examined carefully, it will be observed that each one differs from its fellows and that they differ in a graduated series. The quill is curved in, and the feathered portion or penna is set around this in a helicoidal curve. Here again the portion anterior to the quill is stiff as compared with the portion behind it. Another feature of a bird's wing is that a fore-and-aft vertical section through the body of the wing discloses a curve somewhat of the following shape:

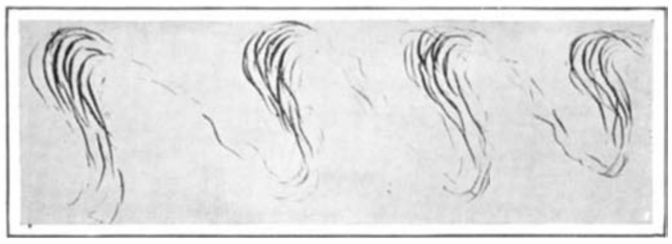


This curve is somewhat more pronounced about midway between the wrist and the shoulder joint, viz., in the region of the elbow. When the wing is in its extended position for flight, this joint is distinctly behind the front edge of the wing.

For the past quarter of a century Mr. E. P. Frost, who is a well-known member of the council of the British Aeronautical Society, has made a close study of the structure of a bird's wing, its functions, and operations. As a result of these examinations, he concluded more than twenty years ago that for ordinary flight the wing is merely beaten up and down. It is therefore obvious that owing to the yielding elastic posterior edge of a bird's wing, on the wing being beaten downward both a lift and a drive forward are obtained. Furthermore, it is apparent that when the wing is elevated, a forward and downward resistance is imparted. But owing to the shape of the wing, the down stroke must perforcedly encounter greater air resistance than the up stroke, apart from considerations of the amount of energy invoked to the up and to the down stroke. Also the arrangement of the wing feathers causes a valvular suction. Air passes through the body and the wing on the up stroke.

Mr. Frost contends that the result of the arrangement of the primaries must be that on being struck downward in the air, their ends travel forward and upward. In flight the wing tips of a bird, for instance a rook, can be seen to be curved upward. If a shed primary feather be taken and held in its natural orientation and struck smartly down in the air, the tip can be observed to spring smartly forward. Then the posterior edge of the penna becomes tense. But when the feather is not so stressed, the posterior edge is sinuous and has a fullness. Other—normal—movements have been described, notably the so-called "figure of eight" curve generated by movements of the wing tips; but Mr. Frost concludes that the movements of the wing tips (particularly the "figure of eight" curve) in what may be considered normal steady flight, are the automatic results of the peculiar construction of the wing, and of its being beaten up and down against the air.

If, during the down stroke, the primary feathers are strained forward and upward within their elastic limits, it is obvious that energy is stored in them, and its restoration may in part occur even in the up stroke.

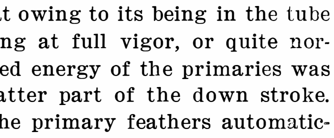


Record of Wing Motion of Birds During Flight. The Bird Flew from Left to Right.

Major B. Baden Powell, who is also intimately interested in the problem of flight, recently obtained the interesting results shown herewith. The curve shown was obtained in the following manner: A number of small birds were procured, and tubes of paper were prepared, the internal diameters of which were approximately the distance between the tips of the oustretched wings of these birds. The internal surfaces of the tubes were covered with a coating of lampblack. A tube was then arranged with one end in a room and the opposite end pointing out into the open air through a window. A bird was then liberated within the inner end of the tube. As it flew toward the light at the outer open end, a record of the movements of its wing tips was obtained. Several observations were made, a fresh tube being requisitioned each time. The curve thus obtained is clearly shown in the diagram. The dotted portion was only faintly visible on the record. Major Baden Powell considers this to represent the up stroke, and that it shows the wings to be slightly flexed on the up stroke.

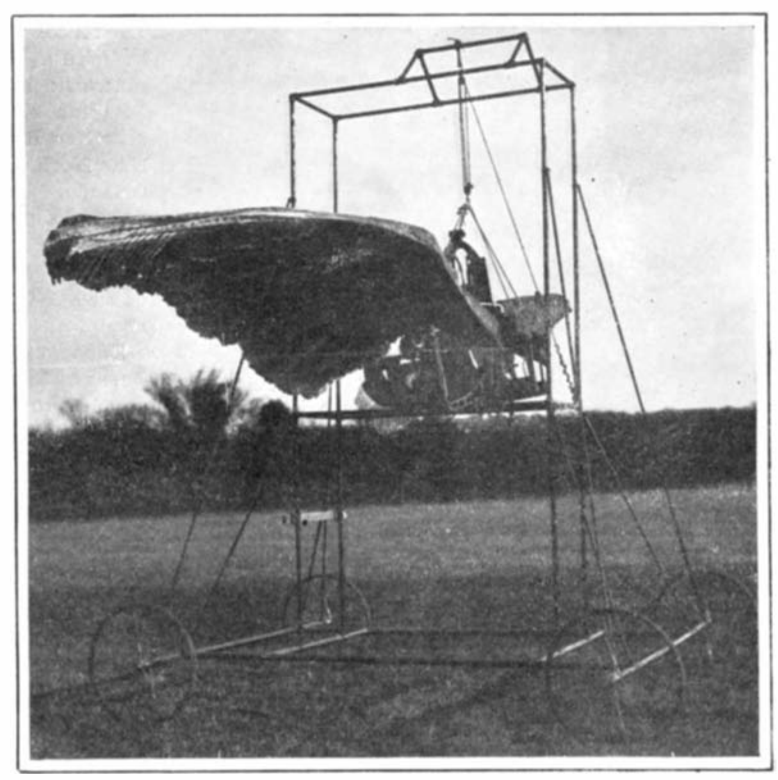
According to Dr. Hutchinson, however, the difference in distinctness between the two portions is due to the wrist being in a slightly flexed condition on the up stroke, in what may be considered the normal position, and that on the down stroke the stressing of the primaries automatically increased the distance between the wing tips, and opened the wrist automatically against its elastic reaction. The wing *as a whole* is essentially an elastic structure. The absence of recurvation at the lower portions of the record, taken in conjunction with the form of the down stroke record, would seem to prove that owing to its being in the tube the bird was not flapping at full vigor, or quite normally, and that the stored energy of the primaries was given out during the latter part of the down stroke. During flapping flight the primary feathers automatically exert a clawing, swimming action.

Referring to the curve mentioned in the earlier part of the article, Mr. Hargrave, of New South Wales, has demonstrated that when air is blown against such a curved surface, thus:



a lift is obtained against the bight of the curve. This

Apparatus for Demonstrating the Lifting and Propulsive Effect of a Bird's Wings.



The Experimental Apparatus with Wing-Planes.

THE BIRD AS A MODEL FOR THE AEROPLANE.

is doubtless due to the formation of eddies of air flowing over the rigid lip.

It is obvious that a bird's wing, both as a gliding and a propelling surface, is a beautifully efficient instrument. To test these conclusions, Mr. Frost and Dr. Hutchinson in co-operation with Mr. D'Esterre in 1902 arranged the apparatus which is illustrated herewith. The experimenters used a pair of natural dried wings with an area of approximately three square feet, in conjunction with a small electric motor and a reduction gear to flap them up and down. The apparatus was suspended by a spring balance from a balanced arm. The following are the best results that were obtained by this crude experiment:

Volts.	Amps.	Estimated loss in motor and gear transmission.	Estimated horse power on wings.	Number of flaps per minute.	Maximum lift.
24	12	75 per cent	$\frac{1}{10}$	350 to 400	5 lbs.

The effect was striking. The bird flapped itself round and round, although it fell between the down strokes. But against this must be set the fact that its rate of progression was only four or five miles an hour, no doubt due to air resistance and friction, which were considerable, for the apparatus was primitive, while the bird also weighed about 21 pounds, which would of course tend to pull down on the up strokes, and the primary feathers were stiff. The oscillations, however, diminished to a very marked extent when the tail was fitted.

It will be observed that the ratio of horse-power to weight was one horse-power to 50 pounds. This ratio coincides with that given by various authorities as that obtaining with birds, and is not in marked contrast with the ratio obtained with the large machine of Messrs. Wright in this country.

Owing to the highly successful results obtained with this primitive apparatus, the investigators resolved upon a larger model with which to continue their researches, and this is shown in another photographic illustration. For the purposes of future experiments, this car is to be run on a special trough section track, and it is intended to arrange in the frame four vertical guides, one at each corner, of stretched cord or wire. The machine is suspended from a spring balance. The model, although possessing certain crudities in the motive portion, will serve adequately for the purposes of the tests it is intended to carry out. It is only intended to act as a testing model, from which some reliable conclusive data may be obtained.

The wings are of special construction, designed in accordance with the principles described in this article. They have a total wing area of about 60 square feet, while the machine measures approximately 20 feet across from tip to tip.

The motive power is transmitted from a gasoline motor of from 3 to 3½ horse-power, through a coned friction clutch and chains in two stages to the connecting rod. The crank throw is adjustable for altering the size of angle or flap. The top sprocket of the second motion can be raised or lowered for altering the limiting positions of the wings (i. e., the position of the arc). The lower end of the connecting rod actuates the inner ends of the levers for wagging the wings by a simple device of two oscillating roller-carrying links attached to the crosshead, whose pin is constrained by vertical guides. Attached to the brackets below the wings are "pectoral cords" of elastic. These serve to store up the energy on the up stroke, and so obviate too violent alterations of load in the driving mechanism.

The wings are at present adjusted to flap one hundred times per minute. This is of course considerably less than proportionately corresponding to the increased area and horse-power. But increased area does not necessarily imply proportionally increased resistance.

Some satisfactory results have already been obtained by means of this apparatus. When suspended from the bough of a tree and set in action under power, at each down stroke the whole machine, apart from the carriage weighing 232 pounds, was lifted bodily up into the air, and at the same time propelled forward. It rises about two feet with each stroke. At the down stroke the suspending rope left the vertical, and became markedly inclined. The pull on the rope then hauled the machine back, so that even if it were capable of flight, it could not fly under these conditions. At the down stroke it appeared that if the rope were then severed, the machine would travel up and away with the powerful sweep of the wings.

The spring balance here is obviously fallacious so far as registering the lift is concerned, because the rope exerts a restraining or backward pull on the machine. However, at the rough test already carried out, the balance showed a diminution of reading of from 80 to 160 pounds at the down stroke when the machine springs upward and also forward.

At the preliminary trial with this apparatus, the wings described a diminished angle as compared with that obtained with the first and smaller model. But with this angle and a velocity of one hundred flaps per minute the wings were capable of evoking a resistance of about 100 pounds each, and the machine was raised about two feet at each stroke. The conditions, however, at this test were not favorable to the machine, as it was near the ground in eddying air, and was not free to get proper forward velocity.

The investigators are of opinion that a feathered wing made of a number of units can exert a greater resistance than a single wing such as that of the insect or bat type, or the various mechanical wings that have hitherto been adopted in wing flapping machines. They are also inclined to the contention that resistance is more dependent on periphery of an aeroplane than on its superficial extent. Furthermore, the primary feathers almost certainly act as a series of stepped aeroplanes, each acting on air from a different level, which has not had a downward velocity imparted to it by having had to sustain the weight of a previously acting supporting surface.

Considerable interest is being evinced in the experiments with this machine in aeronautical circles in England. It is anticipated that some highly interesting data concerning aerial flight will be gathered from the tests that will be carried out by these investigators with this apparatus.

Peat in the United States.

The peat industry can hardly be said to exist in the United States at the present time. A few small operations are now going on, however, and a great number of prospective schemes are being exploited, so that a paper by Mr. Henry H. Hindshaw entitled "Peat in the United States in 1904," which the United States Geological Survey brings out as an extract from the forthcoming volume "Mineral Resources of the United States, 1904," should find numerous readers.

A number of companies have been organized in the Middle and Northwestern States to produce peat fuel by various methods. Some of these are building plants to operate during the summer of 1905. Others do not seem to have advanced beyond the prospectus stage. Many of them promise extraordinary profits by the use of patented processes, often involving the use at some stage of electric devices.

Besides various plants in Canada and Mexico, Mr. Hindshaw makes particular mention of certain plants now in operation in the United States. The Pompton Fuel Developing Company is producing machine peat near Lincoln Park, N. J., and sells all its product to local consumers. Its success on a small scale will probably result in building a much larger plant this year. The machinery in use was imported from Germany and includes a Dolberg breaker and mixer. This company controls a large acreage of peat land in the vicinity of Pompton Plains, N. J. Another plant is in operation near New Rochelle, N. Y., by the Peat Koal Company, of New York, which uses a Schlickeysen machine. At Orlando, Fla., machine peat is manufactured on a machine designed by Mr. T. H. Leavitt, of Boston. A company has been organized in California to manufacture briquettes composed of peat and oil. Some tons of fuel have been made and tested, both for domestic and steam-raising purposes.

The many uses of peat are reviewed by Mr. Hindshaw. Persons interested in the subject on which he writes should procure a copy of his report from the Director of the United States Geological Survey. It will be mailed free of charge, on request.

Foundry Transportation Cables.

The Aumetz-Friede Company at Reutlingen has introduced, according to Stahl und Eisen, important improvements in the transportation of ore from the Aumetz mine to the Friede foundry. The capacity of the system (Pohlig) is five and a half millions of kilometric tons per year, or seventeen hundred tons per day of twenty working hours. There is a principal line from the mine to the factory, with two branches for the blast furnaces and the deposit of ore. The line is 10,750 meters in length and operated by electro-motors installed at the Friede factory. The motor of the principal line works directly a length of 22 kilometers of traction cable. The incline not being great and the line being quite direct, the expenditure of energy is low. The cost of transportation is only 25 pfennigs per ton as against 1.20 marks per ton by the ordinary railway.

The production of quicksilver in 1904 is estimated at 3,391 tons, not including the output of Mexico and Russia, of which no statistics have been received as yet. In 1903 these countries yielded 190 and 362 tons respectively. The production in 1904 of the United States, Spain, Austria, and Italy was 1,480 tons, 1,020 tons, 536 tons, and 355 tons respectively. Counting the output of Mexico and Russia, the world's production for 1904 will probably amount to 4,000 tons.—Richard Guenther, Consul-General, Frankfort, Germany, April 3, 1905.

Correspondence.

Do Animals Reason?

To the Editor of the Scientific American:

Under the above heading the Scientific American of June 3 told of a cat that had learned to open a door by climbing to the old-fashioned thumb catch, and pulling it down with its paw. I can confirm that story. My father had a cat that would open a similar door by jumping up, and while falling pull down the thumb catch with its paw. Afterward the door was changed to open by a turning knob, and, though he could not then turn the knob from the outside, he soon learned that his efforts to do so attracted attention, and he was let in; so he called for admittance in that way instead of mewing. But as a table was so near the door that he could mount the table and reach the knob on the inside, he would paw the knob to try to open the door from the inside, and occasionally succeeded. No one taught him to do these things.

Such cats must have observed how people opened doors, and to my mind they certainly possessed reasoning powers. C. W. Bennett.

Coldwater, Mich., June 5, 1905.

A Tornado's Freaks Explained.

To the Editor of the Scientific American:

I note with some interest and amusement the communication of your correspondent in your issue of May 27 relating to the experience of those caught in the Oklahoma tornado who had their shoes and hair removed by its action. Your correspondent hints at "phenomena which cannot be explained by our accepted physical laws." So far as relates to the shoes, this is in entire accordance with the general action of tornadoes in causing the explosion of receptacles containing inclosed bodies of air, which are suddenly brought into the immediate path of the tornado; and I do not doubt that such an explanation would serve equally well in the case of the hair, more especially if it may be taken for granted that, like the shoes, it was more ornamental than natural.

As relates to the other incidents mentioned by your correspondent, I would suggest the propriety of having these incidents properly authenticated before discussing the reasons for them. While the things which occur are undoubtedly wonderful, they are really nothing to the power of human imagination that is invariably displayed on like occasions. (See Hume "On Miracles.") George W. Colles.

Milwaukee, Wis., May 31, 1905.

Where Did the Photographer Stand?

To the Editor of the Scientific American:

The article in your issue of June 10, 1905, entitled "Where Was the Camera Set Up?" by Prof. William F. Rigge, has been of special interest to me.

I wish to thank the professor for his novel solution of a somewhat difficult problem; and at the same time I take the liberty of calling his attention to the fact that his last statement appears to be somewhat erroneous.

Were the picture plane parallel with the front of the observatory, the mortar lines in the front of the transit room would have retained their normal position in the photograph, but as near as I can tell from the reduced cut, accompanying the article, they vanish at a point on the horizon 347 feet to the right of *O*. This is the vanishing point of east-and-west lines, or *V R*. If a transit is set up at this point and trained on the optical center of the camera, the line will be found to be due east and west, or at right angles with the line from the camera to point *O*. Then train the transit on *O*, and the angle will be found to be very nearly 10 deg. 45 sec. and the course will be N. 89 deg. 15 sec. W., showing that the plate in the camera formed an angle of about 10 deg. 45 sec. with the front of the observatory, instead of about 8 deg., as stated, and the entire front of the building would measure 9/416 inch instead of 4⅛ inches, as it does in the cut, showing that the lines are reduced a little more than 10 per cent. The angle of the picture plane with the front of the building also accounts for the apparent shortening of the wall space at the left of the door to the equatorial room, which, were they parallel, would show a trifle larger than that between the door and angle at the right. B. F. Crawford.

Pittston, Pa., June 13, 1905.

The British government has decided to secure and protect the ancient ramparts erected by Edward I. around the town of Berwick-on-Tweed for the nation. These ruins are of great antiquarian and historical value, since they form one of the most interesting monuments of the bitter strife that existed for centuries between England and Scotland, as they are situated right on the border. The walls include the old bell tower, from which a flaring beacon gave warning to the English farmers of the approach of the bands of marauding Scots. The ruins are to be inclosed and placed under the charge of a curator and guide.

Gardening under Glass in England and France.

A letter was recently written to a local paper suggesting that a trip be arranged to give the gardeners of Evesham, Worcestershire, England, an opportunity to see how the French gardeners cultivate vegetables by the means of glass and make their early produce so great a factor in supplying the London market. The suggestion was acted upon, and a short time ago a party of thirty vegetable growers, large and small, started for Paris. The Evesham growers saw the gardens at Vitry-sur-Seine and found these to consist chiefly of two-acre lots, practically all given up to the growth of early lettuce and other vegetables under glass. The Evesham men thought the soil not naturally better than that in the vale of Evesham, but found that it had been so carefully prepared for so long a time that practically there is not a bit of natural soil in a garden. The methods of preparing this soil and the general methods in use in raising the vegetables as reported by the Evesham men and printed in the Birmingham Daily Mail should be of interest to our Agricultural Department, and are as follows:

"The plan adopted is something of this kind: At the bottom of the seed bed, from which all the top soil has been removed, is a hard bed of clay, and upon this is placed a quantity of stable manure, the stronger at the bottom. Over this is spread about 3 inches of the prepared soil. The lettuce is planted in this in August, the frames are placed over the plants, and are now [February] coming into market. When the crop has been marketed the bed is cleared and the soil and manure mixed well together and built up in mounds to rot. This process takes one to two years, and then this soil is used again to place on the manure. As a consequence the soil is always of the very best and most fertile.

"The frames, which are 13 feet long by 4 feet 6 inches wide, are 9 inches high at the top and 7 inches at the bottom, so that they have a gentle slope to the south. There is no artificial heating except that provided by the manure, but the lights are covered with straw mats, which are very carefully made by elderly men, and which easily roll up. These mats would be very useful for Evesham radish beds, and would prevent a good deal of waste and loss. Water is laid onto nearly every frame by means of pipes from a raised tank, which is filled by a pump, generally driven by horse-power, but sometimes by a gas engine. Great care has to be taken in the ventilation of the frames or damping off may set in. The frames cost about 13s. ($3.16) if bought in large quantities, but they can be obtained for less money in England. They are only used for the raising of cabbage or flat lettuce, and these are planted in rotation, so that as soon as one lot has been marketed another is ready to come in.

"In addition to lettuce, carrots and radishes are planted in the frames, and these come in after the lettuce have been cleared off. Cos lettuce is grown under big glass globes or bells, which cost about a shilling [24 cents] each, and which can be supplied in Evesham at about 1s. 4½d. [33 cents]. About six plants are put under a bell, and when they have made a fair growth three of them are transplanted. After a little time another transplanting takes place, and only one is left under each bell, but so that no space may be lost flat lettuce are placed around each.

"The frames, again, are utilized for the raising of cabbage and cauliflower plants, but despite this help the plants seen this week were at least a fortnight behind those grown at Evesham in the open. This does not seem to show that the climate around Paris, at any rate in the winter, is any warmer than it is at Evesham.

"An asparagus bed was also seen in which a system of culture different from that in vogue at Evesham is used. The roots of this particular bed were exposed to the weather, but they will now be covered with a coating of stable manure and then the earth will be replaced a little at a time. The result is the production of some very fine 'grass.'

"This system is carried out round Evesham, in some instances, with excellent results. Covent Garden (London) was visited as the party passed through London, and the Paris market was also seen, with the idea of instilling into the local growers the necessity of paying more attention to the packing and grading of their produce."

The Mail states it is hoped to organize further excursions into the fruit-growing districts of France, Germany, Netherlands, and Belgium; and arrangements are already being made for another trip in May to France to see how black currants are grown there. The advantage of the French system is that it brings a crop every year, while in Evesham one is gotten only about every three years. The gardeners thought they could compete successfully with the French growers, though they would have to bring their manure from London or Birmingham, but could get it at from 5s. to 6s. 6d. ($1.21 to $1.57) per ton, while the French have to pay at least 5s. 6d. ($1.33) at Paris.

One of the French gardeners said that his working expenses were as heavy as those of the Englishman. To cultivate two acres of land his annual expenses were £600 ($2,919.90), but despite that he could send lettuce to London and compete successfully with the English gardeners.—Marshal Halstead, Consul, Birmingham, England.

The Current Supplement.

The current Supplement, No. 1539, is opened by an article on the Cavite Floating Dock, which has recently been completed for the United States government in the Philippines. The dock is especially notable for the fact that it has the greatest lifting capacity of any similar mechanism ever designed. The article is excellently illustrated. Samuel S. Wyer writes instructively on Gas Producer Power Plants. The article on Glass Paving and Building Bricks is concluded. An entertaining description is given by Mr. Carnochan Douglas of the Curiosities of a Seed Warehouse. T. H. S. Escott contributes an interesting historical *causerie* on Social Pioneers. Dr. Howard D. Barnes writes on the physical properties of ice and water. The Manufacture of Briquettes is thoroughly described and illustrated. Prof. Ernest Ford Nichols, of Columbia University, recently lectured at the Royal Institution on the Radiation and Pressure of Light. An abstract of this lecture is published.

Tunnels Connecting Two Continents.

Of the three barriers to a continuous railway route from Great Britain to Africa through France and Spain, the Moniteur de l'Industrie et de la Construction expresses the satisfaction of the French people that two are prospectively broken down. The tunnel under the Pyrenees will soon be an accomplished fact. The problem of one under the Straits of Gibraltar will be successfully solved by the French engineer Bertier. The length of the latter will be forty-one kilometers, and the depth four hundred meters under the sea. It is difficult, says the Moniteur, to estimate its cost, but judging from the work under the East and North rivers at New York, it cannot be less than 425,000,000 francs. The third barrier to the continuous route, the Straits of Dover, is regarded as unsurmountable at present, in view of the conviction of the English people that safety depends on their insular position.

The rails on the Belt Line Road around Philadelphia are the heaviest rails used on any railroad in the world. They weigh 142 pounds to the yard, and are 17 pounds heavier than any rails ever before used. They are ballasted in concrete, and 9-inch girders were used to bind them. All the curves and spurs were made of the same heavy rails, and the tracks are considered superior to any railroad section ever undertaken. The rails were made especially for the Pennsylvania Railroad by the Pennsylvania Steel Company. An officer of the railroad company states that this section of roadbed will last for twenty-five years without repairs.

EXPLORING FOR FOSSILS.

So much prominence has been given by the local newspapers and periodicals to the opening of the new Dinosaur Hall of the American Museum of Natural History, that the interest of the general public in things palæontologic has been greatly stimulated. Particularly fascinating to the layman are the accounts of the field work of the scientific parties sent out to prospect for fossils or to collect those already discovered. The photographs show how fossils are excavated and forwarded to the laboratories of the museums for restoration, and illustrate in a more detailed manner how this branch of the work is conducted, than those accompanying the article on the *Brontosaurus* restoration in an earlier number of the Scientific American.

Fossil bones are found in various conditions and various kinds of matrices. Usually, the bones are smooth, hard, and brittle, but sometimes they are decayed, and then resemble "rotten" stone. Often they are discovered on the surface, entirely uncovered by the action of the elements, and then need only be collected and wrapped for shipment. Chiefly the jaws and hard, compact foot bones of small mammals are obtained in this way, as they stand weathering better than do other bones. Fossils occur in sand, sandstone, and limestone, but more frequently in a hard, brittle clay shale, and the difficulty encountered in excavating the specimens, of course, depends upon the character of the soil in which they are imbedded. Until the excavation closely approaches the bones, rough tools can be employed—hand picks, spades, and shovels, and, as one of the photographs shows, plows and scrapers. It is only in the case of quarries or of large specimens, such as Dinosaurs, that horses are employed at all, and as a rule the fossils are uncovered on such steep bluffs or hillsides that the use of the teams is impossible.

Fig. 1.—Part of the Skeleton in Its Original Bed, Bone Cabin Quarry.

EXPLORING FOR FOSSILS.

The bones are handled in the field in various ways. If they are delicate, badly mixed up, or crushed, the surrounding matrix is cut out in a block, packed in hay or straw, and boxed or crated. This method is also followed with the remains of the smaller animals. In many cases, as the excavation proceeds, the portions laid bare are covered with sheets of tissue paper or muslin and gum arabic. Over these, bandages of burlap and plaster of Paris are placed, enveloping the entire fossil, and the specimen is ready for crating. This is the procedure where the fossils are not in good condition, if they are "rotten," rough, or cracked by weathering. If they are smooth and hard, the plaster bandages are applied directly, paper or muslin being placed only over such portions as may be in poorer condition. The plaster envelopes of the large bones are sometimes strengthened by wooden ribs or braces. The whole is then bound with wet rawhide strips, and the consequent shrinkage of these on drying binds the whole firmly together. If possible, it is so arranged that no crate or case shall weigh more than 500 pounds.

Sometimes, particularly in the case of smaller, more delicate specimens, flour paste is used instead of plaster. The advantage of this is that the flour is easier to handle and pleasanter to work with, and the envelope is easily removed from the bone by moistening it. Moreover, a pound of flour goes further than a pound of plaster. The latter consideration is of great importance when we consider that the supplies for these expeditions must frequently be transported hundreds of miles into the wilder parts of some of our western States.

It is of vast importance for the work of restoration that the bones be excavated and shipped to the laboratories as nearly as possible in the relative positions in which they were found. Especially is this true where the remains of various animals are commingled, or the single bones are broken and scattered, for to separate the bones properly or to segregate the skeletons requires more care and time than the field party can devote to it. For this reason a large part of the matrix is often not removed until the specimen reaches the museum. Here the plaster envelope is cut away on one side, all the matrix that can be reached is removed, and the bones or fragments freed and separated while still firmly held in their relative positions by the remaining part of the envelope. A plaster bed or layer is now made for the freed side, which is first covered with tissue paper, that the bones may be held in place without adhering to the bed. The specimen is then turned over, and the envelope and matrix are removed from the other side, leaving the entire fossil free for the work of restoration and mounting, but in its original position. In the case of the large fossils, such as those of the gigantic Dinosaurs, where the bones are unbroken, this procedure is usually unnecessary, as the size of the individual fossils is so great that they must be transported separately. Here, how-

ever, the position and condition are carefully studied, sketched, and photographed in the field. For restoring missing parts and binding fragments together, mixtures of dextrine and plaster, or gum arabic and plaster, are used in the laboratories.

Photographs 2, 3, and 6 were taken at or near Como Bluffs in Wyoming. The second of these shows parts of a *Diplodocus* skeleton ready for crating, the wooden ribs imbedded in the plaster, and the whole bound by strips of rawhide. The first is of the partially covered femur and tibia of one of the first of the Dinosaur specimens found at Como Bluffs. These bones were used to supply some of the missing parts of the great mounted *Brontosaurus* at the American museum, as the skeletons were, fortunately, almost identical in size, though the one shown in the illustration was only about one-third complete. The third, No. 6, is of a series of vertebræ partially excavated and covered with sheets of paper. The bone on the extreme left had weathered out first. The sloping bank had been cut away as far as shown, when it was found that the strata dipped almost vertically downward from their horizontal position. Under this condition the further work of excavation would have been extremely difficult, and so the fossil was abandoned in the state shown.

Photographs 1, 5, and 7 were taken at the Bone Cabin Quarry, not far from the Como Bluffs, and are illustrative of three stages in the work of excavation. In the partially uncovered bones the cracks due to weathering are plainly discernible. Photograph No. 4 was taken at Hay Springs, in the northwestern part of Nebraska. It depicts the uncovering of the fossil remains of a mammoth. Both tusks, in a fairly good state of preservation, had been laid bare when the picture was taken. The deposits, of the early part of the glacial period, were extremely interesting. They included the remains of prehistoric camels, deer, peccaries, large ground sloths, mammoths, *Castoroides*—a gigantic species of beaver, one of the largest of all the rodents—Pleistocene horses, and many other smaller animals. Of all the prehistoric horses, the Pleistocene horse most nearly resembled the modern animal, the difference being only in details, such as the teeth. The fossils at Hay Springs were found imbedded in sand, and were uncovered with little difficulty. A curious fact that puzzled the members of the expedition was that nearly all the hollow bones were split and broken. This could not have been due to trampling or crushing by other animals, as the solid bones, no matter how delicate, were usually found intact, and the absence of all traces of man precluded the idea that human hands had been the destructive agency. At length Prof. Osborn, Curator of the Department of Vertebrate Palæontology of the American Museum, advanced the generally accepted theory that the bones had become filled with water, and that subsequent freezing had caused them to burst. In the preparation of this article we are indebted to the courtesy of Mr. Walter Granger and Mr. Adam Hermann, of the American Museum of Natural History.

Fig. 2.—Femur and Tibia of a Dinosaur Found at Como Bluffs and Used in the Brontosaurus Restoration.

Fig. 3.—Several Caudal Vertebræ of a Diplodocus Found at Como Bluffs, Incased in Plaster.

Probably as much has been done to improve the design of propellers as any part of marine machinery. In early days the rules for propeller design were exceedingly crude, but with the slow engine speeds which then obtained the effects were not noticeable. As engine speeds increased it was seen that these old rules were utterly inadmissible. There is no excuse, however, for progress having so long delayed, for the designs remained too crude even after Isherwood's famous Mare Island experiments in 1868. Probably one of the great troubles with screw propeller design at the beginning was the mistake made in considering the action of the screw as analogous to that of a bolt working in a nut, from which it was inferred that the smaller the slip the greater the efficiency. As a matter of fact, a screw propeller is really a pump for driving a mass of water astern, the reaction from which drives the vessel ahead. When this was realized, it was seen that there must be a certain amount of slip and that under proper conditions there could be a large slip and still high efficiency.

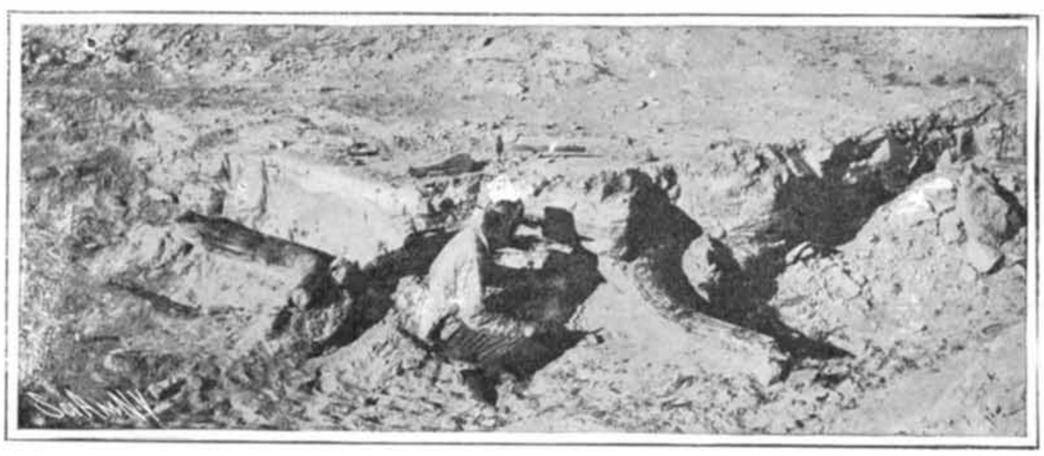


Fig. 4.—Excavating Mammoth Tusks at Hay Springs, Nebraska.

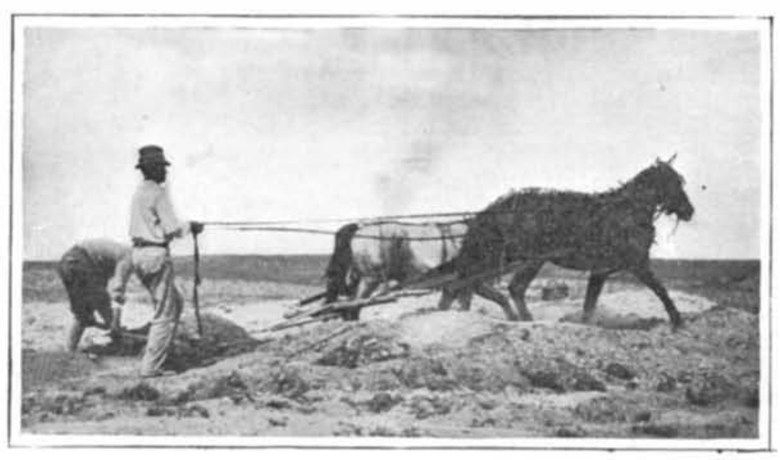


Fig. 5.—Using a Plow at the Bone Cabin Quarry.

Fig. 6.—Partially Exposed Dinosaur Vertebræ at Como Bluffs.

Fig. 7.—Packing the Excavated and Plaster-Incased Fossils for Shipment.

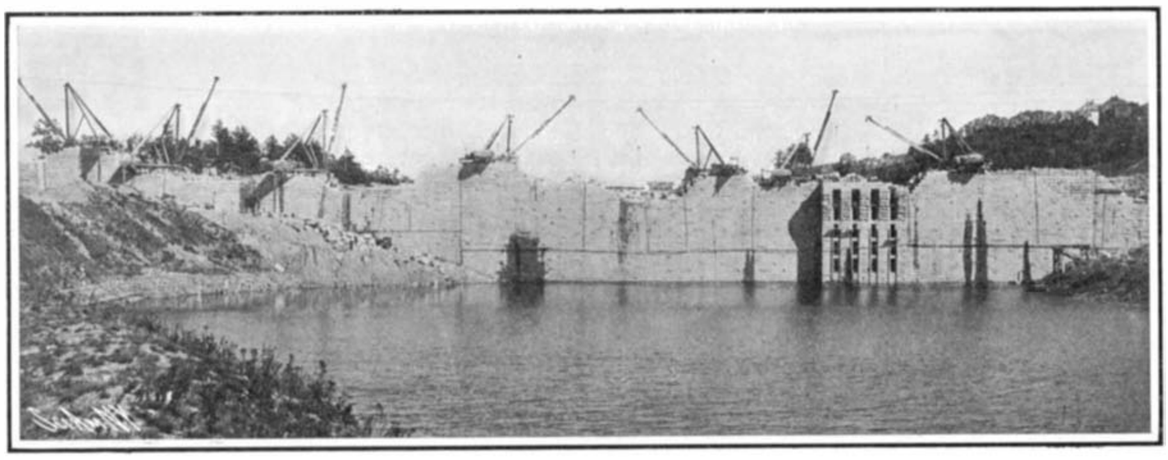
EXPLORING FOR FOSSILS.

THE WACHUSETT RESERVOIR FOR BOSTON WATER SUPPLY.

The completion of the great Wachusett reservoir, for the water supply of the city of Boston and certain neighboring towns and districts, marks the practical conclusion of a great work, which attracted public attention as far back as 1893, when the Legislature authorized the State Board of Health to prepare a plan for a suitable water supply for the city of Boston and its suburbs. At that time Boston was receiving about 57 million gallons daily from a watershed 120 miles square. About five-eighths of this supply came from Sudbury River and its tributaries, and the remainder from Lakes Mystic and Cochituate. There was barely sufficient water to meet the needs of the people, which it was estimated would, in 1895, amount to 84 million gallons daily. In 1895 the Legislature created the Metropolitan Water Board to act for the State.

The plan outlined for future needs was a generous one. A big dam was to be built across the Nashua River near Clinton, which is 35 miles from Boston, to impound 63 billion gallons; thence the water was to be conveyed by a new aqueduct to the new Sudbury reservoir; thence the combined waters of the Nashua, Sudbury, and Cochituate systems were to be carried to the city of Boston, to Chestnut Hill, and to Spot Pond, whence they were to be distributed to the various cities and towns of the metropolitan district, thereby insuring a minimum daily supply of 173 million gallons.

The most important element in these works was the construction of the Wachusett dam and reservoir in Worcester County. The site selected was a most excellent one. The dam serves to impound the waters of the Nashua watershed, which has an area of about 118 square miles, and is capable of yielding, even in a series of very dry years, 105 million gallons of water daily. The conformation of the watershed and of the Nashua Valley was particularly favorable to the location of the reservoir. Near the town of Clinton the valley narrows at a point where good rock foundation is obtained, and presents an excellent side for a dam. Above this point the valley spreads out into a wide natural basin, admirably adapted for reservoir purposes. So favorable is the topography in this basin, that, by the construction of a dam 1,250 feet in length, of which length only 750 feet has a depth from high water to rock exceeding 40 feet, it has been possible to impound over 63 billion gallons of water, thereby forming what is by far the largest fresh-water reservoir in the world. As will be seen from the accompanying table showing the comparative dimensions of some of the most notable reservoirs of the world, the Wachusett reservoir is considerably the largest, having in fact twice the capacity of the Croton dam for the water supply of New York city.



View of Dam from the Upstream Side.

COMPARATIVE TABLE OF AREAS, DEPTHS, AND CAPACITIES OF STORAGE RESERVOIRS, WITH HEIGHTS AND LENGTHS OF DAMS.

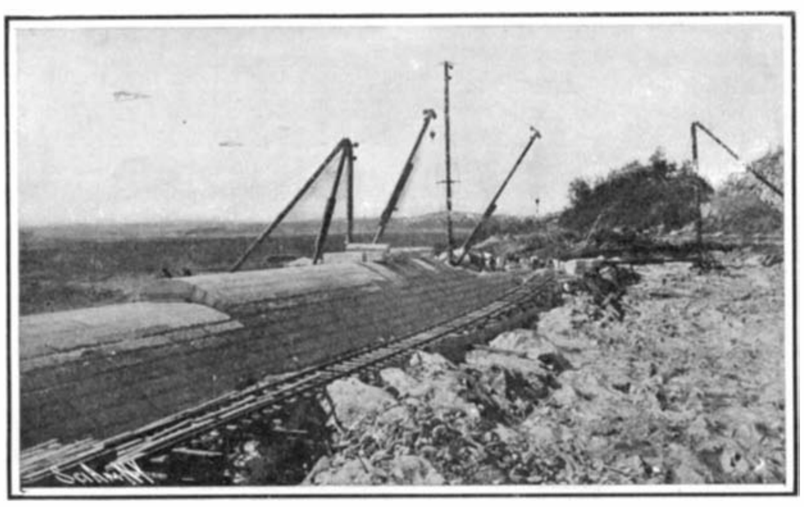
Name and Location of Reservoir.	Area (Square Miles).	Average Depth (Feet).	Maximum Height of Dam. Above Ground	Maximum Height of Dam. Above Rock	Length of Dam (Feet).	Capacity (Million Gallons).
Wachusett reservoir Mass..........	6 56	46	129	158	1,250	63,068
Nira, near Poona, India.......	7 25	27	100	......	3,000	41,143
Tansa, Bombay, India.............	5.50	33	127	131	8,770	37,500
Khadakvasla, Poona India	5.50	32	100	107	5,080	36,737
San Mateo, Cal.	....	....	170	......		32,000
New Croton, N. Y..	....	.....	157	290	1,270	32,000
Elan and Claerwen, Birmingham, Eng., waterworks (total for six reservoirs).	2.34	43	98 to 128	....	4,460	20,838
All Boston waterworks reservoirs combined.....	5.82	14	14 to 65	....	....	15,867
Vyrnwy, Liverpool, Eng	1.75	......	84	129	1,350	14,560
Sodom, N. Y.......	......	....	72	89	500	9,500
Hemet, San Jacinto, Cal............	....	....	150	......	200	8,500
Sudbury reservoir, Boston water works........	1.91	19	65	70	1,865	7,438
Titicus, N. Y.......	....	....	105	115	....	7,000

NOTE.—The heights of dams are given from the ground and rock up to the level of full reservoir. The lengths of dams are the distances across the valleys at the level of full reservoir on the line of the main dam. The capacities are given in United States gallons.

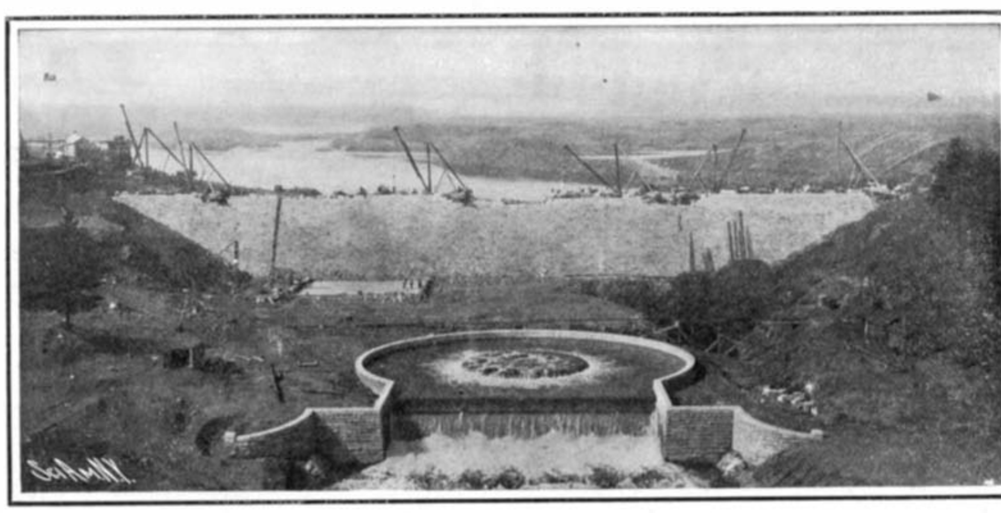
The dam has in cross section the same general form as that of the new Croton dam. It extends 10 feet above the high-water level of the reservoir. It is 19 feet in thickness at the water level, and at 145 feet below the waterline the thickness increases to 120 feet. It is built entirely of first-class masonry laid in cement. The maximum depth from high water to the rock at the downstream edge of the dam is 158 feet.

Nature has provided at the northerly end of the dam an excellent site for the construction of a waste weir and channel for the overflow of surplus water during floods. This waste weir has a length of 450 feet. For the greater part of its length, the crest is constructed at the level of the full reservoir; but for a length of 120 feet, the crest, as shown in one of our engravings, is a few feet higher; and by the use of movable gates on the lower level of the crest, it will be possible to raise the height of water in the dam by several feet, if desired. The gate house of the main dam is served by four 48-inch pipes, which perform the double purpose of supplying water to the aqueduct leading to the Sudbury watershed, and of conveying the waste water to the river below the dam. These pipes alone, because of the large head upon them when the reservoir is about full, will have sufficient capacity to take care, unaided, of the waters of a large freshet. The combined relief afforded by these pipes and spillway above mentioned will give ample protection against the severest floods that can occur in the watershed above.

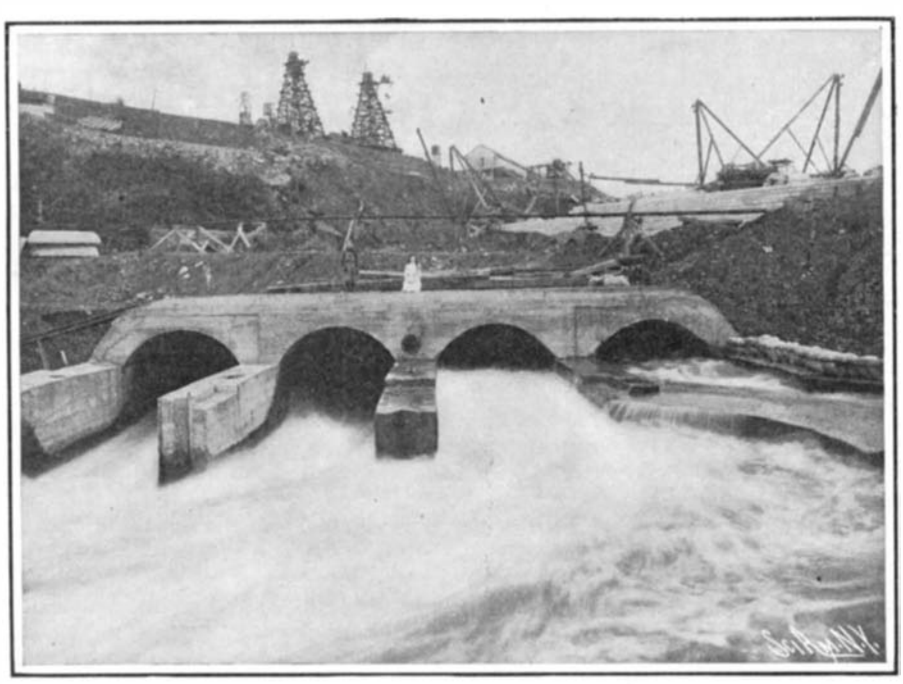
The construction of the masonry of the dam was by



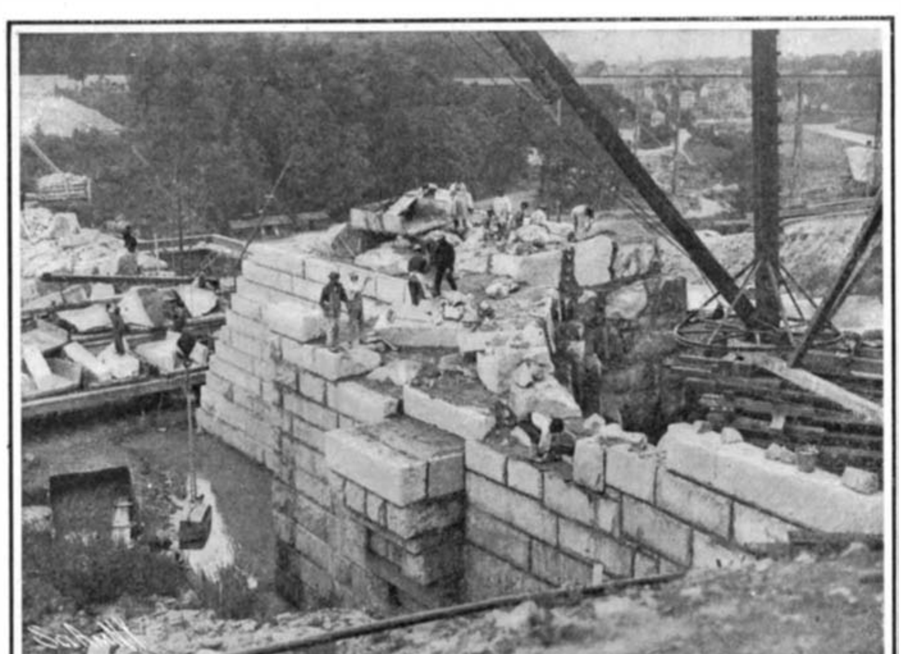
The Waste Weir from the East.



Pool and Spillway Below the Dam.



Discharge through Conduits During High Water of June 22, 1903.



Easterly End of the Dam During Construction.

THE WACHUSETT RESERVOIR FOR BOSTON WATER SUPPLY.

no means all the work that had to be done to impound this 63 billion gallons of water. Huge dikes had to be built to the north and south of the main dam, to fill in certain low places in the higher contour lines of the dam, and prevent the outflow of water in those two localities. Moreover, the Metropolitan Water Board very wisely reached the conclusion that the brush, peat, mud, and minor organic accumulations at the bottom or along the sides of reservoirs and basins soiled the water and infected it with living organisms. Consequently, they determined to undertake the heroic task of scraping the surface soil from the whole of the 6½ square miles occupied by the reservoir, carrying out this cleaning operation until either bedrock, sand, or mineral earth was reached. An average of 9 inches of black loam was taken from the wooded land, and 11½ inches from the cleared land. Now, this general cleaning up served a double purpose; for it not only insured a better quality of water, but the material removed served for the construction of the great north dike, which runs along the northerly side of the reservoir for a total length of 8,550 feet. This dike extends 15 feet above the high-water level, and it is 50 feet in width at the top. On the reservoir side of the embankment, the slope consists of a thick bed of impervious gravel covered with heavy riprap. There is another dike on the southerly side of the reservoir, which is one half a mile in length, and extends 10 feet above the high-water level. This dike consists of an earth embankment, with an impervious concrete core wall, which is carried down to the solid rock and extends vertically as a diaphragm through the center of the earth dam until its top is above high-water level. It should be mentioned that the removal of the greater part of the soil was done by means of a railway and special soil-scraping material. The magnitude of this soil removal is shown by its total cost, which reached the sum of $3,000,000.

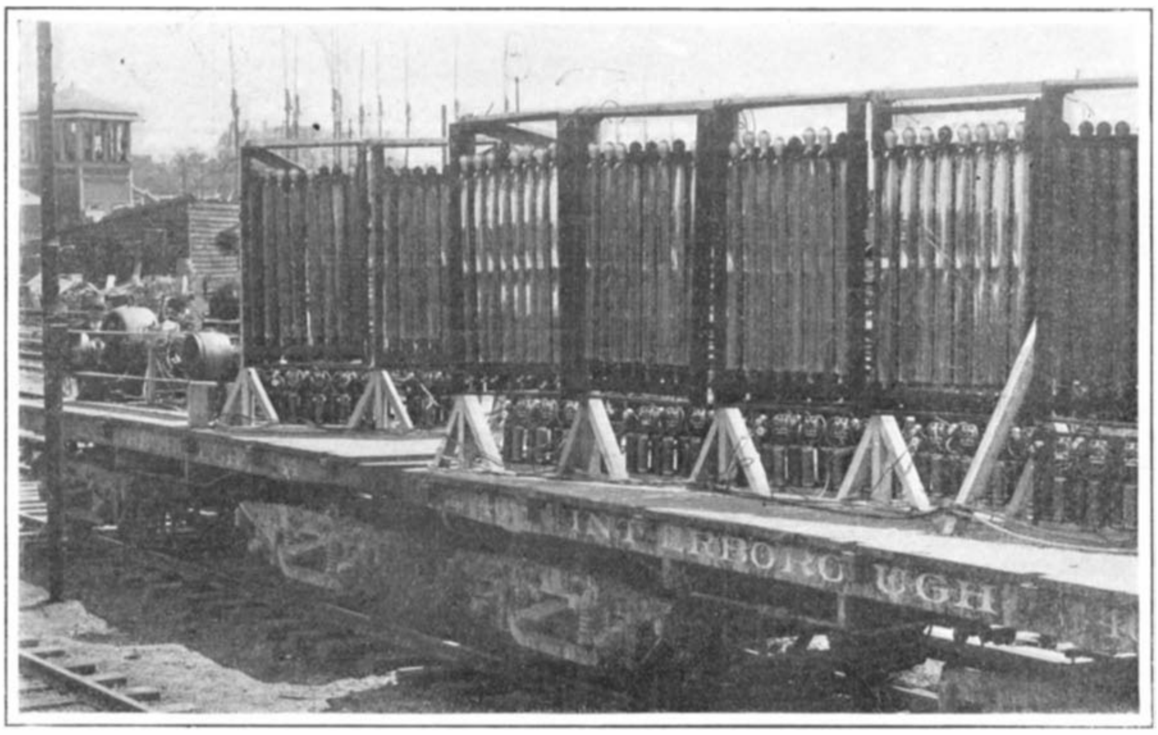
The area flooded by the new reservoir includes 2,000 acres of cleared land, 1,801 acres of wooded land, 81 acres of stump land, and 313 acres of water surface. The elevation of the reservoir is 385 feet above the Boston water works base, thus affording an adequate height to reach the highest buildings in Boston. It is interesting to note that preliminary to the soil-clearing operations, it was necessary to remove, among other buildings, 6 mills, 4 churches, 6 schoolhouses, and 224 dwellings. Moreover, 1,711 people dwelt upon the land required by the reservoir. The mere settlement of claims formed a large part of the expense, the outlay for which reached a sum of over $2,000,000.

The proper and most convenient measure of boiler furnace efficiency would be the composition of the gases leaving it, as determined by analysis. According to the above definition, a furnace would not be a portion of some steam-generating apparatus; for example, when a grate is located immediately under the boiler. In other cases, such as with many stokers, the furnace feature is only partially developed. With such fuel as anthracite coal or coke, a furnace would have a minimum value, and its maximum value would be realized with bituminous coal.

PHOTOGRAPHING THE NEW YORK SUBWAY.

BY FRANK C. PERKINS.

A most interesting and novel equipment has recently been utilized in taking moving pictures in the Subway between 14th and 42d Streets in New York, showing loading and unloading of the trains, the platform scenes being taken at Grand Central Station, 33d Street, 23d Street, and 14th Street. A special car was provided by the Interborough Rapid Transit Company, as shown in the accompanying illustration, provided with seventy-two Cooper Hewitt mercury-vapor arc lamps, each of 750 candle power, producing a total of over 54,000 candle power. From a photographic point of view, on account of the great actinic quality of the light, this value is multiplied many times. There were nine banks of eight 55-inch mercury-vapor lamps mounted in frames and arranged diagonally across one flat car, so that the light was thrown immediately ahead of the car upon which the camera was mounted and to one side. The flat car containing the generating apparatus received current from the third rail, and operated a motor generator set consisting of a 40 horse-power Westinghouse direct-current quadripolar motor at a pressure of 550 volts. This motor was belted to a four-pole Westinghouse direct-current generator having a capacity of 22.5 kilowatts, and supplying a continuous current of 110 volts pressure to the Cooper Hewitt lamps, which were mounted in front of polished metal reflectors. A switchboard table was provided, upon which were mounted the necessary controlling switches, ammeters, and voltmeters. The mercury lamps were started by means of kicking coils arranged along the bottom of the frame, and the various banks of lamps were coupled together by means of fiber couplings, so arranged that the frames could be tilted forward or backward as desired. The pictures were taken by the American Mutoscope and Biograph Company, by a special machine mounted on an iron framework with several compartments, one above the other, provided with a rapid crank movement and special projecting lens, the pictures being taken at the rate of 900 per minute. The local and the express trains were open to passengers, the flat cars being located just far enough behind the rear car of the local to show the train clearly while in motion, and showing the interchange of passengers between the local and the express trains. The time of exposure was seven minutes, so that the film included 6,300 pictures. At the Grand Central Station a stop of several minutes was made, the mercury lamps illuminating the station perfectly, the crowds of passengers being taken in every detail as they were alighting from the trains, other passengers taking their places. It is stated that the details of the Subway construction were photographed with remarkable distinctness, although the trains were moving at high speeds, the high actinic power of the lamp giving excellent results. The photographs were taken under the direction of F. A. Dobson, of the Biograph Company, and L. B. Stillwell, electrical director of the Subway, while the running of the trains was under the direction of the Subway Superintendent, A. L. Merritt.



THE 54,000 CANDLE POWER COOPER HEWITT MERCURY ARC LAMPS.

These are three of six thousand three hundred pictures taken in the New York Subway at the rate of nine hundred per minute. The chronophotographic apparatus and the seventy-two Cooper Hewitt Lights by which the pictures were taken were mounted on a flat car which followed up the regular Subway trains.

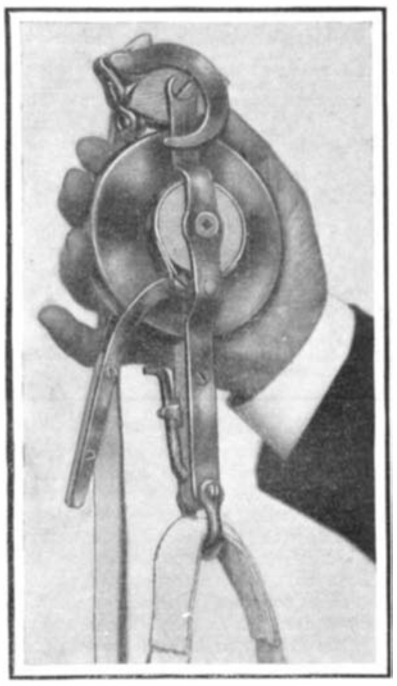
PHOTOGRAPHING THE NEW YORK SUBWAY.

A contest is to be held on the occasion of the Milan Exposition of 1906, by the Association of Italian Industries for security against accidents in work. This association proposes to award the following prizes for different kinds of safety appliances. A gold medal and the sum of $1,600 will be awarded for a new device which will entirely suppress the danger to life coming from a contact which may eventually be formed between the primary and secondary circuits of an electric transformer. This apparatus is to be constructed so that while responding to its principal function it can neither interrupt nor alter the working of the transformer under the influence of a rise of tension or from an atmospheric discharge. A gold medal and the sum of $200 will be awarded for a good form of crane or hoist provided with a simple and practical device which will absolutely prevent the rotation of the cranks on the descent of the load. A gold medal and $100 is offered for a simple, strong, and effective apparatus for automatically stopping cars which are moving upon an inclined plane in case the traction cable should break. This apparatus is to be applied to already existing plants. A gold medal is to be awarded for a practical device for exhausting and collecting the dust which is formed during the sorting and cutting of rags by hand. Such a device should satisfy the proposed conditions without causing drafts which might be injurious to the workmen's health. A gold medal is offered for an apparatus for localized exhaust and successive elimination of dust which is produced during the cardage of flax tow, hemp, jute, etc. This device is to be used where the above operations are carried out so as to improve the health of the workmen, without having any harmful effects upon the neighboring localities. A gold medal is awarded for an effective device which will prevent the diffusion of dust in places where the preparation of lime and cement is carried on. Demands for admission to the concourse should be made before July 31 of this year to the above-named society, Foro Bonaparte 61, Milan. The first three devices are to be exposed in working order, while a model of the last three can be presented. Models and inventions will remain the property of the inventors. The society is to publish a description of the best apparatus.

Caseine Cement.—In 95 parts of water dissolve 5 parts of borax, and to this solution add enough caseine to obtain a mass of good consistency.

AN EFFICIENT PORTABLE FIRE ESCAPE.

In the accompanying engraving we illustrate a small but very efficient fire escape, which will be found useful in hotels, or may be kept in the home, ready for use in case of emergency. No hotel is perfectly fireproof, and a traveling man is constantly exposed to the danger of fire. For such a person this fire escape is particularly advantageous, because it occupies a minimum of space in the valise or trunk. It consists essentially of a roll of steel tape, coiled on a drum, and having a grapple attachment to the free end, which may be hooked over the window sill. The drum is completely inclosed in a casing, except for a pair of hubs which project on opposite sides, and carry a pair of brake bands attached to a brake lever, as shown more clearly in our enlarged view of the fire escape. The drum is mounted on a shaft, which has bearings in a pair of side straps. The latter extend below the drum, and form a handle by which the apparatus may be grasped. A shackle is attached to the lower end of the handle, and this carries a belt, which may be passed around the body of the escaping person. In use with the grapple hooked over the window casing, and the belt buckled around the body, the operator seizes both the handle and brake lever in his hand, and lowers himself out of the window with an extra strap hooked at one end to the grapple. When ready, this strap is released, and the tape is then let out under control of the brake bands; that is, the downward motion can be entirely arrested or varied in speed by varying the grip on the brake lever. The weak point in many fire escapes is to be found at the points where the tape or rope is attached. In the present case the attachment is so made that the tape is not weakened in the least. At the point where the tape issues from the casing, a guide roller is provided to prevent its being bent too sharply. The fire escape may also be used to lower a child, or a person who has lost control of his senses, by inverting the device and attaching the person to the strap hooked to the grapple. In such case, the brake lever is operated by a person remaining at the window above. A crank handle is provided, which may be fixed to the drum shaft to rewind the tape. A patent on this fire escape has been granted to Mr. David N. Luse, of Carroll, Iowa.



AN EFFICIENT PORTABLE FIRE ESCAPE.

METHOD OF USING THE FIRE ESCAPE.

A NOVEL TOBACCO PIPE.

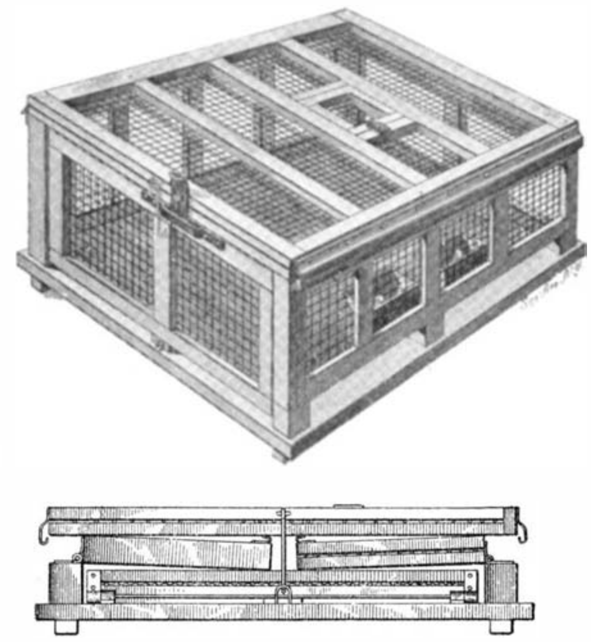
A pipe has long been considered the ideal means of smoking tobacco, except for certain objections which inventors have for years been endeavoring to overcome. The jet of hot smoke issuing from the pipe stem and striking the tongue usually at one spot is apt to produce great irritation and generally induces an abnormal flow of saliva which enters and clogs the pipe stem. In the accompanying illustration we show a novel pipe recently invented by Mr. C. Elkin, Times Building, New York, which is so constructed as to cool the smoke before it issues from the stem. Furthermore, a mouthpiece of peculiar design is provided, which deflects the smoke and directs it in several tiny jets toward the roof of the mouth, and not against the tongue. The mouthpiece is also adapted to prevent entrance of saliva into the stem, or if by chance any does enter, it entirely prevents the saliva from being drawn out again. Our engraving shows the bowl and stem partly broken away to indicate the course of the smoke through the pipe. It will be observed that a small smokeway leads from the bowl to a large chamber at the rear, thence the smoke is drawn up through a small opening into an inverted conical chamber in the stem, whence it passes through a small bore to the nozzle, entering there a cap or mouthpiece from which it is finally drawn into the mouth through orifices in the upper wall of the cap. It will be evident that as the hot smoke enters the first large chamber it immediately expands, giving off a portion of its heat, when in the stem chamber a second expansion results in further cooling the smoke, and finally at the cap a third expansion takes place, so that when it enters the mouth it is materially cooler than smoke drawn through an ordinary straight stem. Furthermore, the several orifices distribute the smoke over a broader area. The usual oily deposit collects largely in the first chamber, from which it may be readily removed with a strip of blotting paper. The upper walls of the stem chamber, and also the rear wall of the cap, act as baffles, producing a whirling of the smoke and causing a certain amount of deposit, which, however, cannot in any way be sucked into the mouth. A small air hole is drilled into the stem just above the nozzle. Ordinarily this is covered with the lip, but, when desired, this hole may be uncovered, permitting the entrance of air into the stem, which mixes with the smoke and further cools and dilutes it. In this way the smoker can vary the strength of the smoke he is drawing in.

A NOVEL TOBACCO PIPE.

IMPROVED FOLDING COOP.

An improved folding coop adapted for the transportation of poultry by boat or rail, is illustrated in the accompanying engraving. While similar in many respects to certain folding coops now in general use, it embodies some additional details of construction, which render it very substantial either when erected for service or when folded into a compact package, and which enable the production of the coop at a moderate cost. The general construction will be evident by a glance at the engraving. A rectangular base of thin boards, battened together, has hinged to it at each end a pair of end walls comprising the usual frames and wire screen fillings. Similar walls are provided at the sides, but these are hinged to the posts at such a height that when the end walls are folded down the side walls may be folded to lie flat over them. The cover of the coop is made of a single large frame with panels of wire filling in it. It is provided with stout hooks at each end, which, when the coop is folded, are hooked into staples on the baseboard, and lock the parts firmly together in folded condition.

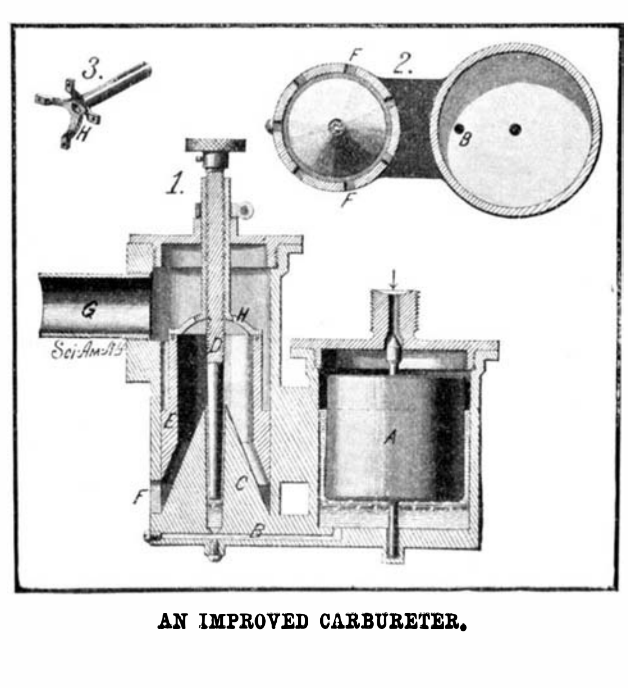
In setting up the coop, the top is first removed, then the side and end walls are swung up. Hasps are hinged to the side walls, and hook over staples on the end walls being locked in place by hooks. After the sides are secured, the top is slid endwise into position. Along the top of each side piece is a hook plate adapted to engage a corresponding hook plate on the cover, as shown in the engraving. This holds the top from being lifted off, and prevents side movement, but to prevent end movement, a latch bolt is mounted at one end of the cover, and this may be moved down into engagement with a staple or a keeper-loop on one of the end walls. A hand hole provided in the cover consists of a pivoted door, which may be rocked open by pressing on one end. The coop when used for temporarily housing live fowls is provided with sheet metal receptacles for food and water, above each of which a canopy projects to prevent entrance of dirt. Messrs. Robert Yoakum and Patrick C. McKee, of 4514 Wood Street, Brumer, Texas, have recently secured a patent on this improved coop.



IMPROVED FOLDING COOP.

AN IMPROVED CARBURETER.

A carbureter of new design has recently been invented by Mr. John T. Orr, of Dillon, Mont., Box 245. This carbureter has for its main object to secure an absolutely intimate association of the sprayed hydrocarbon and the air, and to provide devices facilitating the absolute control of the carbureter, so that the volume of air and fuel admitted to the engine may be regulated at will without varying the proportions of mixture. As indicated in the accompanying engraving, the construction includes a float chamber in which there is a float, *A*, adapted to regulate the supply of gasoline. The float chamber is connected by a passage *B* with the carbureter chamber. The bottom of this chamber is formed with a cone, *C*, in the center of which is a gasoline passage. This passage is tapered, and operating in it is a pin valve, *D*, which is correspondingly tapered, so that by adjusting the valve upward or downward, the area of the gasoline passage may be regulated. Over the cone, *C*, is a tubular member, *E*, provided at the lower end with a tapered surface, the pitch of which corresponds with that of a cone. The annular passage between this surface and cone connects at its lower end with the air inlets, *F*. Fastened to the upper end of the tubular member is a spider, *H*, formed with a hollow shank, which is threaded over the stem of the pin valve. The hollow shank is held by friction in the cover of the carbureter, and may be adjusted to open or close the annular pipe to any desired extent, and at the same time, it is evident, it will open or close the gasoline passage. It will thus be seen that the invention provides first for independent adjustment of the valve and sleeve, to attain the proper proportion of air and oil, and then for a combined regulation of the quantity of mixture which may be drawn up by the engine sucking through tube, *G*. The invention may be used to great advantage in connection with a governor for automatically controlling the fuel supply, and in this case the governor connection will be attached to the tubular shank of the spider.



AN IMPROVED CARBURETER.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRIC SELF-WINDING CLOCK.—A. VON KASPIS, Weehawken, N. J. This invention relates to escapement-clocks driven by spring-motors; and its object is to provide an electrically-self-winding clock arranged to require but a comparatively small spring for driving the clock-work, to reduce the work required by the spring to a minimum, to insure accurate running of the clock at all times, and to permit of dispensing with a pendulum.

TROLLEY.—L. McD. STEELE, Middletown, Ohio. Mr. Steele's invention has reference to trolleys or like conducting devices employed in connection with electric cars, and more particularly to means for preventing displacement of the contact member thereof from the conductor. Its principal objects are to provide a simple and effective mechanism of this character.

Of Interest to Farmers.

WEEDER.—T. G. THOMPSON, Deerfield, Wis. This implement may be readily applied over a growing plant and operated to remove weeds around said plant without in any way injuring it, and by turning the shanks of the blades in one direction or the other the blades may be set forward or back to either throw the soil toward or away from the growing plant from which the weeds have been removed.

HAY-PRESS.—J. M. GURLEY, Denton, Texas. One purpose in this case is to provide a construction in which pulleys and wheels and all surplus rollers are dispensed with liable to render the machine clumsy and difficult to keep in repair. And another, is to snugly locate the power appliance of the machine, which appliance is of simple construction, on a strong frame and to provide for the plunger-shaft operating in well-adapted guides, reducing to a minimum the possibility of the shaft giving away or breaking.

Of General Interest.

BUCKLE.—L. CABALKA, Lesterville, S. D. The invention is in the nature of a harness-buckle, and has for its principal objects to prevent catching and tearing of the fly-net, the horse's tail being caught thereby, and marring by rubbing action against other parts, as the harness-saddle, strap, etc. It is intended for use on the reins, but is equally adapted to other parts of harness where it is desirable to provide protection afforded thereby.

AMUSEMENT DEVICE.—J. C. BOYLE, Portland, Ore. Mr. Boyle's invention refers to improvements in amusement devices in the form of slideways designed not only to afford pleasure to children but serving as a means for healthful exercise, the object being to provide a device of this character that will be simple in construction and inexpensive, and that may be used indoors or in open air, and that may be conveniently folded for transportation or when not in use.

CIGAR-HOLDING DEVICE.—T. B. ERWIN and H. C. MEYER, Britt, Iowa. The invention has reference particularly to improvements in devices for holding and delivering cigars whereby they may be readily ejected one at a time from a coin-controlled vending-machine —such, for instance, as shown in the Messrs. Erwin and Meyer former application for coin-controlled vending machines.

PARALLEL-RULE.—P. CUMMING, Keywest, Fla. In the present patent the invention has reference to parallel-rules, the principal objects of the improvement being the provision of various adjustments in such a device and for the lifting of one blade while the other remains upon the work.

BEARING FOR VENTILATOR-SHAFTS.—T. M. CARPENTER and F. L. BAKER, Los Angeles, Cal. The special objects of the present invention are to improve the devices for mounting the ventilator-fan so that it will be securely held and enabled to operate with the least possible friction. The invention is adapted particularly to the device embodied in a prior patent granted to the inventors.

FOLDING UMBRELLA.—W. S. CONNELL, New York, N. Y. In Mr. Connell's patent the invention pertains to a folding umbrella, parasol or similar device. The principal object of the invention is to secure a construction of umbrella or the like which will permit it to be folded up into such small compass as to be easily placed in the pocket.

PUMP.—T. M. PEARSON, New York, N. Y. The invention relates to means for applying heavy pressure to liquid or semi-liquid substances. It is especially intended as a means for forcing lead into crevices between the plates of ships to prevent leaks therein, although it is useful in other connections, as will be apparent to skilled mechanics.

BUILDER'S BLOCK.—G. J. ROBERTS, Wakeman, Ohio. One object of the invention is to provide a block which can be held by transverse and longitudinal wires in such manner that a series of blocks may be brought together one series on the other and each series have an interlocking engagement, forming a fireproof wall and a wall which protects its supports, and at the same time each block in the wall is so closely in contact with an engaging block as to prevent the possibility of flames passing between them in case of a fire.

MANIFOLD PAD-LEDGER.—A. F. SCHULTZ, Danville, Ill. This form of pad serves as a ledger. Construction is such that with the aid of an attached carbon-sheet a complete entry of articles bought when entered upon a pad will be transferred to an underlying sheet, which is given to the buyer, the original entry sheet remaining on the pad, so that when a credit customer buys again the sheets on the pad may be quickly looked over and amount unpaid quickly known without reference to regular ledger and added to the last entry sheet, so that at each transaction a creditor will have record of amount owed previous to last order and total amount due at date of issue of last duplicate order sheet, and at same time the merchant has a similar entry on the pad to refer to when next credit transaction by same party is made.

CONNECTING MECHANISM.—H. E. SMITH, Roslyn, Wash. Mr. Smith's invention relates to mechanism for connecting threaded elements, it being particularly applicable to the caps of hydrants and the like. Mere application of the wrench effects the unlocking of the actuating mechanism, and half a turn so frees the cap that it may be withdrawn by direct pull, thus providing for speedy and effective operation, features exceedingly desirable in connection with fire apparatus.

FIRE-ESCAPE.—G. F. WACHTERSHAUSER, Wilkesbarre, Pa. The invention has for its objects the provision of a fire-escape which shall be easily accessible from all parts of the building, which shall take up very little room, shall have few parts to get out of repair, which shall secure a rapid descent and a cushioned fall near the ground, and which shall be simple and cheap to construct.

WRENCH.—C. H. SMITH, Allentown, Pa. In this wrench the jaws similar to those of an ordinary monkey wrench are carried by a shaft mounted to turn and to move longitudinally in its support so as to enable the jaws to be moved into the most convenient position to engage the nut. The support in which the shaft has bearings has a laterally projecting head on which the ratchet handle is mounted to turn and has ratchet teeth to be engaged by the pawls of the handle.

SAW-HANDLE.—G. M. REDDY, Bowie, La. In the present patent the improvement has reference to a handle intended specially for drag or cross-cut saws; and the object of the inventor is the provision of a handle which may be readily applied to saws of various sizes, holding them with entire security.

Heating and Lighting.

HEATING-STOVE.—C. MILLER, Scranton, Pa. It is intended by Mr. Miller that a heating-stove provided with the additional heating-surface as he has invented will not only radiate to improved degree, but by minimum use of coal. By constructing an air passage-way into sections with slip-joints a burned-out one thereof may be readily replaced by simple vertical adjustment of the next-above section.

INCANDESCENT BURNER.—D. FRIED, New York, N. Y. The purpose of the improvement is to provide an incandescent or mantle burner which will be of economic construction and which can be attached to a bracket and be supported in a pendent, upright, or a horizontal position or intermediate positions without in the least interfering with the position of the mantle relative to its supporting-tube.

Household Utilities.

SAD-IRON.—J. COOK, Paterson, N. J. The invention pertains to improvements in sad-irons of the class designed to be heated by a gas-flame within the body portion, the object being to provide an improvement of this class so constructed as to retain the heat for a considerable length of time after extinguishing the flame, thus permitting the use of the iron when detached from a gas-feed pipe.

WINDOW RAISING AND LOCKING DEVICE.—F. BRUNO, New York, N. Y. In this case the invention pertains to improvements in window-sash raising and locking devices of that class shown in a former patent granted to Mr. Bruno, the main objects being to simplify the construction of the device shown in the patent by omitting certain features thereof, thus resulting in economy of production and making it more effective in operation.

Machines and Mechanical Devices.

MACHINE FOR DRAWING IN WARP-THREADS.—U. GANZ and A. W. FRANÇOIS, Wilmington, Del. The present invention has reference to weaving textile fabrics; and the object of the inventors is the provision of a new and improved machine for drawing the warp-threads into the reed in an exceedingly accurate and quick manner and without the aid of skilled labor.

Pertaining to Vehicles.

HARNESS-TRACE.—T. J. WAVRUNEK, Shawano, Wis. The improvement relates to traces for harness provided to couple a draft-animal to a wagon or truck, and has for its object to provide novel details of construction for traces, which confer great strength, reduce weight, and enable a comparatively light gage or thickness of leather to be employed, the improved features affording a neat, shapely trace at a moderate cost.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of the paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Inquiry No. 6981.—For manufacturers of distilling apparatus for making whiskies and brandies.

Inquiry No. 6982.—Wanted, a machine for making mesh fly nets.

Inquiry No. 6983.—Wanted, a second-hand hydraulic hoist, for foundry use, and which is capable of lifting one ton twelve feet high.

Inquiry No. 6984.—For the present address of the Freeland Marine Gasoline Engine Co.

Inquiry No. 6985.—For the manufacturers of the Hitchcock Improved lamp.

Inquiry No. 6986.—Wanted, to have a water filter made, cast or spun, in brass.

Inquiry No. 6987.—For manufacturers of copper lightning rods.

Inquiry No. 6988.—Wanted, the address of builders of oil furnaces.

Inquiry No. 6989.—For the manufacturers of the Morse Thermo-Gage Electric Pyrometer.

Inquiry No. 6990.—For manufacturers of feather decorations for millinery.

Inquiry No. 6991.—For dealers in poultry and eggs.

Inquiry No. 6992.—Wanted, a small, portable soap press.

Inquiry No. 6993.—For parties to make special designs in blown glass.

Inquiry No. 6994.—For manufacturers of liquid rubber.

Inquiry No. 6995.—For manufacturers of fertilizer machinery and ice plants.

Inquiry No. 6996.—For manufacturers of ice machines.

The Patentee or Manufacturer of the best railroad track bolts with lock nut device will please mail to me illustrated and descriptive circular of same, together with cost per ton, stating his place of manufacture, etc.

A. B. Hart, Jacksonville, Fla.

Inquiry No. 6997.—For dealers in the breakage and sweepings of incandescent electric lamps.

Advertiser, having ample facilities for manufacturing, desires to meet party who thoroughly understands the manufacture of small dynamos, motors and electric fans, who is already engaged in or desires to enter into manufacturing. Address Dynamos, 794 Broad Street, Newark, N. J.

Inquiry No. 6998.—For manufacturers of cocoanut oil and copra from the cocoanut.

WANTED.—The patents or sole agency for Britain and France, of new machines and articles used in the Brewing and Allied Trades. Highest references given and required. State best terms with full particulars to "Wideawake," care of Streets Agency, 30 Cornhill, London, England.

Inquiry No. 6999.—For firms making small castings, such as used on step ladders and coffee mills.

Splendid opening for a high-grade mechanical engineer, who has had a broad experience in managing machine shops, the manufacture of machinery, engines and metal specialties. Applicants must be in prime of life and now employed. Preference will be given to applicants who have had modern scientific training in mechanical schools of high standing. Unqualified references will be exacted. All communications received will be regarded as strictly confidential. Address

Mechanical Engineer, Box 773, New York.

Inquiry No 7000.—Wanted, machines for cutting butter in 56-pound boxes into one-pound blocks.

Inquiry No. 7001.—For parties manufacturing refrigeration machinery for small plant to cool about 30,000 cubic feet, for butter, eggs and cheese.

Inquiry No. 7002.—For makers of twisted wire, or other display racks, on which to display bottles on counters.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9668) A. V. V. says: 1. If a cylindrical block of wood be set on end, resting on a thick layer of dirt (composed largely of sawdust and minute chips, such as accumulate in a woodshed), and the block be repeatedly struck with the back of a heavy ax, why is it that the dirt and dust under the block will collect, instead of scattering, and form a compact, cone-shaped mound, so elevated and pointed that the block will be upset by the blows, though struck each time in its very center? A. Never having seen the phenomenon which you describe, we are unable to explain with positiveness its cause. We imagine, however, that the tendency of each blow is to drive away some of the dirt and dust around the outside of the block; also, as the block rebounds there would be a very slight suction which would tend to draw some particles toward the center. The combination of these two causes is very likely responsible for what you describe. 2. Why is it that one can drive a hollow iron tube (such as is used for driven wells) into the ground more rapidly and with less expenditure of force, by using a wooden maul and striking comparatively light taps, than can be done with a heavy iron sledge and powerful blows? A. In driving a hollow iron tube into the ground the blow must be struck in such a way that the end of the pipe will have time to penetrate into the soil. If too heavy a blow is struck it will tend to buckle the pipe and also cause it to vibrate throughout its length. Both of these things very much increase the friction on the side of the pipe and interfere with its penetrating as far as it otherwise would.

(9669) H. E. asks: Should Peary find an open passage to the north, how will be know when he is exactly on the pole? A. The latitude of a place is found from the altitude of the sun and stars above the horizon at noon. If one were on the north pole, the sun would circle around the sky at the same altitude all the twenty-four hours of the day when it was above the horizon at all. As one would only reach the pole in the summer, it would be perpetual day, and the observation of the sun would be continual.

(9670) M. I. asks: 1. Please explain how platinum wires are fused into thermometer bulbs so as to be in the right place. The thermometers I refer to have the wires fused into the tube and when the mercury reaches them, it completes an electric circuit and registers the temperature in the furnace room. I cannot understand how the wires could be put in the right place to register any given number of degrees. A. The platinum wires are fused into the thermostat tubes before the thermometer is filled with mercury. The size of the bulb containing the mercury is adjusted so that the wire shall be at the right place. The method of calculating the proper size of bulb is given in Deschanel's "Physics" under the construction of thermometers. It is quite as necessary in making a clinical thermometer as in this case. All thermometers in fact must be adjusted to their desired range of temperature. 2. In December 17 SCIENTIFIC AMERICAN you spoke of people in America raising medicinal plants. Where could they find a market for them? A. Drug plants would be sold to druggists or to wholesale dealers in drugs in cities. Druggists will often buy them and send them to their correspondents in cities. 3. While experimenting with Geissler tubes, I noticed that they would light up if I held one pole in my hand and the other near an operating induction coil. Why was this? I took one of the tubes in each hand and touched one to each terminal of the coil; they lighted up bright. The current must have passed through me. Why didn't I feel it? I know I could not have taken it from terminals themselves without great injury. A. A Geissler tube lights by induction when held in a strong electric field. The electrical waves pass through the space and the tube just as they do in wireless telegraphing and the tube receives them and shines by them. When you touched the ends of the tubes to the terminals of the coil you felt no effect because the current was very small which passed through the tubes and you —one or two milliamperes, perhaps. It is possible to hold a lamp in the same way to a high potential transformer and have it come to full candle power.

NEW BOOKS, ETC.

APPENDICITIS AND OTHER DISEASES ABOUT THE APPENDIX. By Bayard Holmes, B.S., M.D. New York: D. Appleton & Co., 1904. 12mo.; pp. 350. Price, $2.

The organs of the head and the thorax, from their extremely delicate nature and their inclosure within bony or membranous substances, are risky subjects for surgical manipulation. But the dozen organs of the abdomen are not so open to these objections, and may be examined and subjected to palpation with comparative ease. Dr. Holmes treats, in this volume, of surgical practice as applied to what he terms "the most mournfully interesting and unique structure in the body." There are many illustrations. Those representing the ideal manikin, with luminosities to indicate the centers of disease, are particularly good.

BALANCE. The Fundamental Verity. By Orlando J. Smith. New York: Houghton, Mifflin & Co., 1904. 12mo.; pp. 286. Price, $1.25.

Mr. Smith takes the physical law, "to every action an equal reaction," and restates it in relation to the psychic realm. As every physical transformation includes exact equivalence and compensation, so, he holds, do the transactions and interactions of the ethical life carry with them recompense and retribution. Of course he admits that our present existence seldom sees justice completed; but from this very fact he argues the reality of a future existence, in order that the supreme law of equivalence may be fulfilled. Not the least noteworthy part of the work is the appendix, composed of criticisms of the author's position by prominent thinkers, together with the author's own replies.

THE LION'S SKIN. By the Hon. John S. Wise. New York: Doubleday, Page & Co., 1905. 12mo.; pp. 404. Price, $1.50.

This is a historical novel of a very unusual type. Instead of being a novel with a historical setting, it is rather a history embellished with an interesting story. It describes political conditions during the Reconstruction Period. Very little authentic has been written concerning this period, but we are informed that the present work of Mr. Wise is largely autobiographical, which makes it particularly valuable as a history. Many personal experiences and observations are recounted, and a new light is thrown on the trying conditions of that time. The purpose of weaving a story into the history is evidently to make the latter more vivid. The historical data are thus brought to the attention of many readers who are not interested in history as such.

MODERN THEORY OF PHYSICAL PHENOMENA. By Augusto Righi, Professor of Physics in the University of Bologna. Translated by Augustus Trowbridge, Professor of Mathematical Physics in the University of Wisconsin. New York: The Macmillan Company, 1904. 12mo.; pp. 161. Price, $1.10.

This book gives an elementary treatment of the electron theory as it stands to-day. Its author is a well-known Italian investigator and contributor to electrical science, and he is well qualified to discuss and explain the theory, both because of his deep insight into electrical phenomena, and of his ability to explain intricate physical processes without the aid of mathematical formulæ. The book was written with the object of interesting the greatest possible number of readers in this new and important branch of physics, and the English translation will, no doubt, aid in causing it to do this. Electrolytic Ions and Electrons; Electrons and the Phenomena of Light; Mass, Velocity, and Electric Charge of the Ions and of the Electrons; Nature of the Cathode Rays; Radio-Activity, and the Electrons and the Constitution of Matter are all discussed in a lucid manner.

MANUFACTURING COST. By H. L. C. Hall. Detroit: The Bookkeeper Publishing Company, Ltd., 1904. 16mo.; pp. 191. Price, $3.

This book forms one of the volumes of the "Office Library Series." It gives full information along general lines of the manufacturing cost of different classes of goods and the various systems used in different businesses in manufacturing and marketing goods. The manager of any large business or factory will, no doubt, find many useful hints in its pages.

LOCI IN MECHANICAL DRAWING. By Alex. MacLay. Manchester: The Technical Publishing Company, Ltd., 1904. 8vo.; pp. 120. Price, $1.

The present volume forms Part III. of this work, and is on Piston Acceleration. The aim of this part is to introduce the student of drawing to a class of Loci which are neither geometrical nor mechanical, according to the distinction drawn in Part I., viz., between points supposed to move under purely geometrical conditions, on the one hand, and point paths in mechanisms on the other. Curves of velocity and acceleration are here discussed and worked out in connection with

piston motion in engine mechanisms of the slider crank order. As the problems thus arising are generally considered more suitable for advanced than elementary students, and also on account of the nature of the subject, the graphical has been made to go hand in hand with the mathematical in the present instance, thus presenting a kind of exercise of great value to drawing students. Several different methods have been shown for arriving at the same result, the work being as complete and explicit as it is possible to make it.

THE COPPER HANDBOOK. By Horace J. Stevens. Published by the Author at Houghton, Mich., 1904. 8vo.; pp. 778. Price, $5.

The revised, fourth edition of this manual of the copper industry of the world will be found extremely useful to all who are in any way connected with this great mining business. The present edition is more complete than any former edition in a number of ways. The statistical tables have all been revised and brought up as near to the close of 1903 as possible. The chapter devoted to detailed descriptions of 3,311 copper mines and copper mining companies throughout the world is very complete, and all these descriptions have been brought up to date. The descriptions have been amplified, and the number of mines and mining companies is one-half greater than heretofore. Besides the descriptions mentioned, the book contains several complete chapters on the history of copper, the geology of this metal, and the chemistry, mineralogy and metallurgy relating to it. The book also has a complete index and glossary of mining terms.

INDEX OF INVENTIONS

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AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

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